TODD PACIFIC SHIPYARDS CORPORATION SEATTLE DIVISION P.O. BOX 3806 SEATTLE, WASHINGTON 98124

ALUMINUM WELDING

OUT-OF-POSITION WELDING OF 5000 SERIES ALUMINUM ALLOYS USING PULSE GMAW POWER SOURCES

FINAL REPORT JANUARY 1984

MIKE Y. NAKATA
PRINCIPAL INVESTIGATOR

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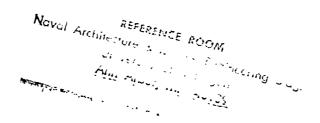
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VOLUME I

TABLE OF CONTENTS

- 1. Foreword
- 2. Acknowledgements
- 3. Table of Contents
- 4. Introduction
- 5. Process Description
- 6. Pulse GMAW Power Sources & Accessories
- 7. Base Materials: 5000 Series Aluminum Alloy Sheet & Plates
- 8. Filler Materials: 5000 Series Aluminum Alloy Filler Wires
- 9. Weld Joint Designs
- $10. \quad \hbox{Shielding Gases \& Weld Characteristics}$
- 11. Material Preparation
- 12. Weld Joint Fit-Up
- 13. Weld Tests



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FOREWARD

This report primarily describes the weld test work conducted during the development of welding procedure qualification data, welding techniques and welding procedure specification relative to full penetration, one-side, out-of-position, manual pulsed gas metal arc butt welding of 5000 series aluminum alloy sheets and plates for marine fabrication.

This project was conducted with the use of basic "off-the-shelf" welding power sources (less than \$5,000], feeders, guns and accessories currently available to all U.S. Shipyards.

Our literature survey indicated that substantial information covering gas metal arc welding (GMAW) of aluminum alloy is available. However, very little information appeared available on manual one-side, full weld penetration gas metal arc butt welding of 5000 series aluminum alloy sheets and plates in all welding positions with the use of either pulse or short-arc welding modes on the pulse arc equipment. The short-circuit mode has not been applied commonly to aluminum welding since it had originally been developed for steel in CO gases.

No high speed oscilloscope nor high speed motion pictures were taken to interpret the physical meaning of GMM in the pulse spray transfer or IN the "pulsed short-circuiting" arc welding modes. All testing was conducted on a one-on-one basis, i.e. the welder vs. attainment of full penetration, one-side, out-of-position manual gas metal arc welding of marine aluminum alloy sheet and plate.

It is anticipated that some of the results and techniques developed might be implemented as an improved cost-effective approach to hull, superstructure, sheet metal and piping fabrication. It is also anticipated that fabricators of surface effect ships, hydrofoils and crew boats may find applications of some information developed.

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TABLE OF CONTENTS

- 1. Foreword
- 2. Acknowledgements
- 3. Table of Contents
- 4. Introduction
- 5. Process Description
- 6. Pulse GMAW Power Sources & Accessories
- 7. Base Materials: 5000 Series Aluminum Alloy Sheet & Plates
- 8. Filler Materials: 5000 Series Aluminum Alloy Filler Wires
- 9. Weld Joint Designs
- 10. Shielding Gases & Weld Characteristics
- 11. Material Preparation
- 12. Weld Joint Fit-Up
- 1.3. Weld Tests
- 14. chipping
- 15. Welding Techniques
- 16. Repair Welding
- 17. Preheat, Interpass, Post-Heat Temperatures
- 18. Mechanical Properties
- 19. Weld Machine Settings
- 20, Welding Procedure Specification: Guide
- 21. General Conclusions & Recommendations
- 22. References

INTRODUCTION

Substantial gas metal arc welding (GMAW) developmental work on aluminum and aluminum alloys has been conducted by the Navy, Aluminum Manufacturers, and the Shipbuilding Industry itself. However, very little work has been conducted to develop out-of-position, full penetration, one-side, manual gas metal arc butt welding of aluminum alloys with the use of pulse spray or "pulse short-arc" modes. This phase of manual gas metal arc welding of aluminum alloy sheet and plates has not been fully developed nor fully utilized by the shipbuilding industry.

The pulse spray and also the short circuiting arc welding mode is a variation of the gas metal arc welding process. The pulsed arc welding power source usually provides a dual-level welding current and provides substantially improved weld deposition control for out-of-position welding. Both the background and the pulsed peak welding current can be controlled separately or electronically so that the actual average welding current is precise. In the past, out-of-position GMAW in the spray mode could not be used effectively because the molten weld puddle was so hot that the puddle sagged or rolled because of gravity. With the use of the new pulsed GMAW power sources, however, the use of the background level provides sufficient cooling of the weld puddle to allow out-of-position welding. Radiographic inspection quality levels were anticipated to be superior to conventional GMAW welds, i.e. per MIL-STD-0900-003-9000; "Radiographic Standards For Production and Repair Welds."

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The primary purpose of the project was to determine and establish manual pulsed gas metal arc welding techniques and also welding machine settings for the one-sided fusion welding of strain hardened 5000 series marine aluminum alloy sheets and plates in the 1/16 inch to 1/2 inch thickness range. The primary objective was to make manual butt welds in the horizontal, vertical-up and overhead welding positions and produce full penetration root weld pass deposits with the minimal use of strong backs and without the use of either metallic or ceramic back-up bars. The welding test piece parts to be welded were gas metal arc GMAW tack welded only and were fixtured with minimal restraints.

The primary objective of this project was to produce out-of-position, full penetration, manual gas metal arc GMA. butt welds from one-side and yet meet weld quality levels similar to those attained with the use of gas tungsten arc welding GTAW. It was felt that substantial (30%-50%] cost savings could be attained as a result of overall increased productivity and minimum distortion weldments realized through out-of-position, one-side, full penetration gas metal arc welding.

The advantages of pulsed spray welding were primarily higher deposition rates when welding out-of-position. The other advantages are as follows:

Rework, repairs, or straightening costs would be minimized because full penetration welds usually eliminate repairs on lack-of-fusion type defects.

Weld quality levels similar to gas tungsten arc welding can be attained. Weld distortion is held to a minimum because of low heat input and good depth/width ratio weld cross sectional configuration.

Less weld repairs will be encountered.

Easier and greater working ranges for out-of-position welding will be appreciated.

However, in spite of the many advantages that the pulse arc process provides, many welding people have avoided it because of two major factors; 1] higher cost of the welding machines/system and; 2) the complexity in setting the machine up to the proper pulse voltage peak vs. background voltage balance in addition to taking care of the other necessary machine variables.

Also, in the past many welders and welding engineers have shied away from using the conventional GMAW short-circuiting arc process when welding aluminum alloy sheet/plate materials in the out-of-position mode. This was because the droplet transfers were uncontrollable due to improper balance of slope, inductance, electromagnetic pinch force, pulse amplitude, pulse duration, pulse frequency and voltage feedback control systems.

It is anticipated that the results of this report may encourage aluminum and aluminum alloy fabricators to consider the advantages of manual pulsed arc welding of aluminum and aluminum alloy sheet and plate materials by utilizing the out-of-position, full penetration, one-side welding technique.

For clarity's sake, various discussions, comments and often conclusions and recommendations follow a specific topic because of the numerous welding variables involved in this study.

PROCESS DESCRIPTION

In order to define pulsed arc welding, it appears necessary to define gas metal arc welding GMAW which is more commonly known as MIG welding or metal inert gas welding.

GAS METAL ARC WELDING: GMAW

The American Welding Society (AWS) defines gas metal arc welding GMAW as follows:

"An arc welding process wherein coalescence is produced by heating with an arc between a continuous filler metal (consumable) electrode and the work. Shielding is obtained from an externally supplied gas."

The basic GMAW system usually consists of a power source, wire feeder with controls, welding gun (torch) and shielding gas system and accessories. See Figure 1.

The standard (non-pulsed) gas metal arc welding of aluminum alloys in the spray transfer mode is used primarily for welding plate materials (.188 inch thick and greater) and sheet materials (.125 inch thick and greater). When the conventional spray transfer mode is used the welding is usually done in the flat position. This is because the higher current levels make the weld puddle very fluid. In the GMAW spray transfer mode the fine metal droplets are pinched off the wire and and propelled across the arc gap to the work as illustrated in Figure 2.

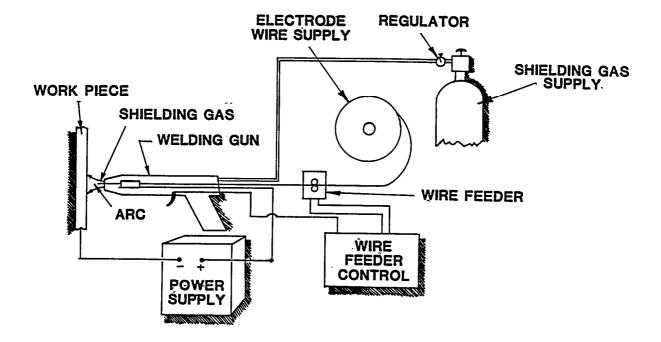


FIGURE 1

GAS METAL ARC WELDING EQUIPMENT

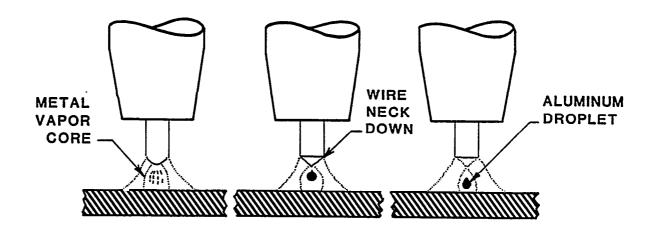


FIGURE 2

GMAW: SPRAY ARC

PULSED GAS METAL ARC WELDING

Pulsed arc welding is a variation of the gas metal arc welding GMAW process. With pulsed GMAW, the welding power source(s) provides a dual level welding current and provides substantially improved weld deposition control especially for out-of-position welding applications. Both the background and the pulsed peak welding currents can be controlled separately so that the actual average welding current may be set more precisely than with the use of conventional GMAW power sources.

In pulsed spray gas metal arc welding the current is varied between a high (peak) and low (background) value. The low level of current is below the non-pulsing transition current while the high on the peak current level is well into the spray arc region, i.e. if the upper current were continuous, it would provide spray transfer and if the lower current were continuous it would produce globular transfer. Metal is transferred to the work during the peak current levels. Figure 3 illustrates the pulsed GMAW welding current cycle pattern. In the spring of 1983, most of the "off-the-shelf" pulsed arc power sources manufactured in the United states appeared to use pulse in either 60 or 120 pulses per second. However, one manufacturer has recently begun manufacturing a pulse GMAW power source covering an approximate range of 50-250 pulses per second.

When using argon or argon rich mixtures or 75% helium/25% argon gas shielding with the pulsed GMAW process, a spray transfer occurs above the transition current value for a given electrode and diameter involved. As the current density at the electrode is increased, the end of the filler wire (electrode) will form into a droplet because of the "pinch effect". Droplets of molten aluminum appear much smaller than wire diameter and are propelled by the arc force. See Figure 4.

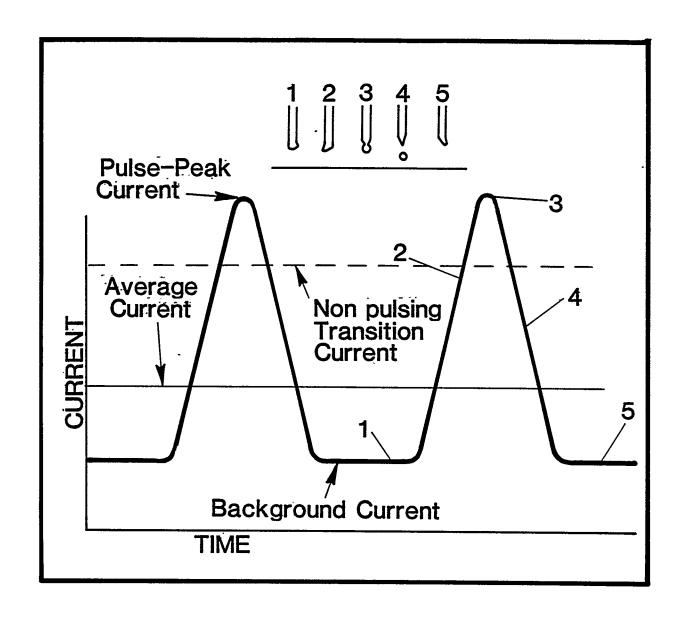


FIGURE 3

TYPICAL PULSE GMAW CURRENT CYCLE PATTERN

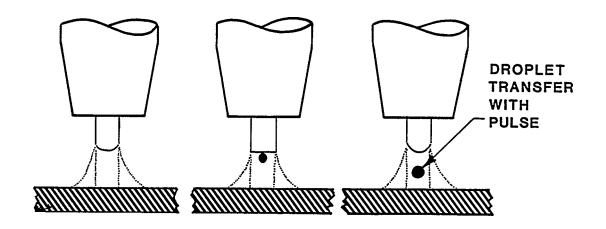


FIGURE 4

PULSED GMAW: PULSED SPRAY

The three methods of metal transfer in pulsed gas metal arc welding are pulsed spray, globular and short-circuiting transfer.

PULSED SPRAY TRANSFER

As discussed earlier in the text, the pulsed arc GMAW process utilizes a peak and background current levels producing an average current value. The resultant current level is a lower average current heat level than when a continuous conventional spray transfer mode is used. The tip of the filler wire melts and the molten metal drops transfer in a spray during each current peak pulse when most of the energy input as utilized for melting the base material and the filler wire material. Usually, there is not sufficient time for globular transfer to occur and more than adequate time at temperature for spray transfer to melt the electrode. Adjustment of both the pulse peak and amperage and background is usually available unless these functions are electronically pre-programmed. The arc is maintained by the background current. The pulse peak current must be set high enough so that the metal droplets are propelled through the arc at a high velocity for one-side, full penetration, manual pulsed gas metal arc welding in the out-of-position mode.

The droplet size tends to stay the same but the rate of drops transferred increases with frequency, i.e. from 50-250 pulses per second (pps). Most power sources pulse only in 60 or 120 pps. The cooler arc is attained by using the lower pulse, i.e. 50 pps or 60 pps depending on the power source.

With the use of the conventional continuous (standard GMAW) spray arc, it was difficult for the average "new hire welders to make out-of-position welds. The work usually had to be positioned for down hand (flat) welding. On the other hand, with the use of the pulse current a lower heat input spray arc transfer may be used for welding in the vertical-up, horizontal and overhead welding positions.

The pulsed gas metal arc process permits the use of larger diameter wires with the use of push wire feeders. A much lower average current may be

used with 3/64 inch diameter wires than is possible for the conventional GMAW process. Larger diameter filler wires generally provide better wire feeding capabilities in addition to better weld deposit quality, i.e. .030 inch diameter filler wires have lower columnar strength and requires a pull qun.

GLOBULAR ARC TRANSFER

When pulsed gas metal arc welding power sources are used, the globular arc transfer usually occurs below the pulse peak current corresponding to the conventional non-pulsing transition current level. This globular transfer range covers the minimum current density which will melt the filler wire up to the point where higher peak amperage produces a pulsed spray transfer.

With the use of conventional gas metal arc welding power sources, the globular transfer usually is avoided because the arc cone covers a much larger area and causes shallow weld penetration, lack of fusion, and irregular metal deposition and certainly is not suitable for out-of-position welding.

"PULSED SHORT-CIRCUITING ARC"

As described in the previous paragraphs, the conventional globular arc transfer does not lend itself to one-side, out-of-position full penetration manual gas metal arc welding. See Figure 5. The Airco PA-350 power source in the "short-circuiting mode" does not appear to be the same as the conventional short-arc mode. When the globules short-circuit by coming in contact with the puddle and electrode at the same time the arc force is so strong that the molten globules have good arc stability and provide good full penetration welds with good depth to width ratio.

Unfortunately, no high speed motion pictures at 3,000 frames per second were taken and also the use of a high speed oscilloscope was not available.

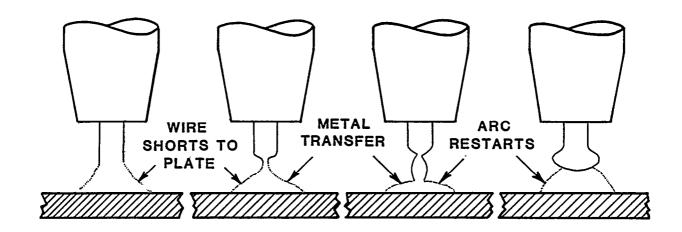


FIGURE 5

STANDARD GMAW: SHORT CIRCUITING

The advantages of the pulse and "pulse short-circuiting" modes of gas metal arc welding are as follows:

Permits the welder to make a one-side, full penetration, out-of-position weld using the manual GMAW process.

Provides cooler arc and less distortion.

Minimizes weld spatter and undercutting.

Permits the out-of-position welding of thin sheet materials, e.g. .063 inch thicknesses of aluminum alloy sheet.

Permits spray transfer welding at average currents below those normally possible.

Provides improved arc control for out-of-position welding and more effective welding of thin gauge material, with all the advantages of spray transfer, i.e. minimizes excessive weld puddle fluidity.

Permits use of larger diameter electrode wires which cost less, feed easier and also have a lower surface-to-volume ratio which reduces the possibility of weld porosity and, in some cases, weld cracking.

Provides precision control of current to assure bead shape and root penetration approaching GTAW quality.

1 ^

PULSED ARC GMAW POWER SOURCES

When this project was originally proposed in the Spring of 1982, only one production model "off-the-shelf type" pulsed GMAW power source appeared to be available in the United States. This was the Airco PA-3A. Since that point in time, however, American manufacturers have begun producing pulsed GMAW power sources, primarily because of the interest in utilizing the advantages offered by low heat input for joining quench and tempered steels such as HY-80/HY-100 for submarine and other marine applications.

The original scope of this program stipulated the determination of the "best" pulsed GMAW power source for welding aluminum. However, during the course of this program it was determined that the preferred power source should be left as a choice of individual shipyard Welding Engineers for their particular application. As this program progressed, it became more evident that the establishment of the "best" power source would be extremely subjective and difficult. It would result in the unfair comparison of dissimilar GMAW power sources, and wire feeder systems, i.e. not suitable for comparison. Furthermore, many of the equipment manufacturers are working on their next generation pulse power sources.

The welding power source designed for pulsed gas metal arc welding is usually a constant voltage type. Pulsed GMAW power sources usually have added pulse features which significantly improve arc stability, weld puddle control, weld arc column shape, and also provide a wider and controllable spray arc transfer working range.

The program covered four types of pulsed arc welding power sources. These are as follows:

- 1. Airco PA-3A
- 2.Airco PA-350
- 3. Gilliland CV 600 FI-PA
- 4. Miller Pulstar

Each pulsed GMAW power source has its own special merits and areas of applications. They all appeared to operate according to the same basic principles of a GMAW power source. However, substantial variations in welding power source specifications appear in areas such as process modes, pulse rates (pulse per second), pulse source(s), and pulse control method, etc.

During the welder familiarization period with the four candidate pulse arc welding power sources, it was surprising to discover that the short-circuiting arc mode needed to be included as another alternative approach to attain our primary program objective, i.e. full weld penetration from one-side, out-of-position manual GMNT. As described in the previous paragraph under Process Description, the "new" short arc mode does not appear to be the conventional short-circuiting arc transfer with which most of us are familiar.

The four pulse GMAW power sources are described in the following paragraphs.

* * * * * * * *

AIRCO PA-3A

The Airco PA-3A for pulsed arc welding has two transformer-rectifiers connected in parallel. A three phase full wave rectifier SCR provides the background current and controls the arc length. A single phase rectifier provides the pulsing current.

The dual power source is used only in the pulse spray mode: 60 or 120 pps.

When using the Airco PA-3A, the welder is confronted with the following items listed below:

Power on/off toggle switch.

DC ammeter (0-500 amperes).

DC voltmeter (0-100 volts).

Three position voltage toggle switch (peak, average, background).

Pulse rate toggle (120 pps vs. 60 pps].

Pulse peak, pulse width potentiometer knob.

Background pulse switch extra 10w vs. normal.

EXTRA LOW

NORMAL

Toggle Switch #1 = 8.5A ys. Off + Toggle Switch - Raise ys. Lower

Toggle Stitch #2 = 8.5A vs. Off+

Toggle Switch #3 = 17.0A vs. off

See Figure 6.

The volt-ampere tune, the metal transfer sequence and the schematic for the Airco PA-3A are shown in Figure 7, 8, and 9 respectively. The Airco PA-3A welding power source, AHF-NP pull feeder, and AH35-C2 gun is shown in Figure 10.

The following procedures are used to set up and calibrate the Airco PA-3A pulsed GMA welding machines.

1. Visual check of mechanical and electrical components.

- 2. Hook up primary power and check main contactor for proper operation.
- 3. Check voltages on transformer secondaries for proper output.
- 4. Check phasing on transformer secondaries.
- 5. Calibrate firing circuit printed circuit board for minimum and maximum pulsed width.
- 6. Check background voltage.
- 7. Check meter accuracy against oscilloscope.
- 8. Load test output for maximum voltage amperage.
- 9. Set up with wire feeder and weld test.

NOTE :

The above check list is reduced to items 2, 6 and 9 only in order for a user to set-up.

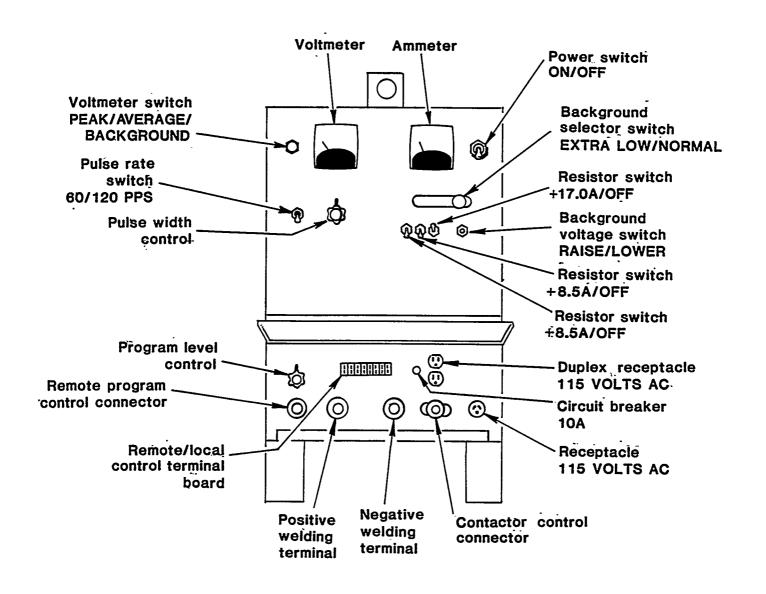
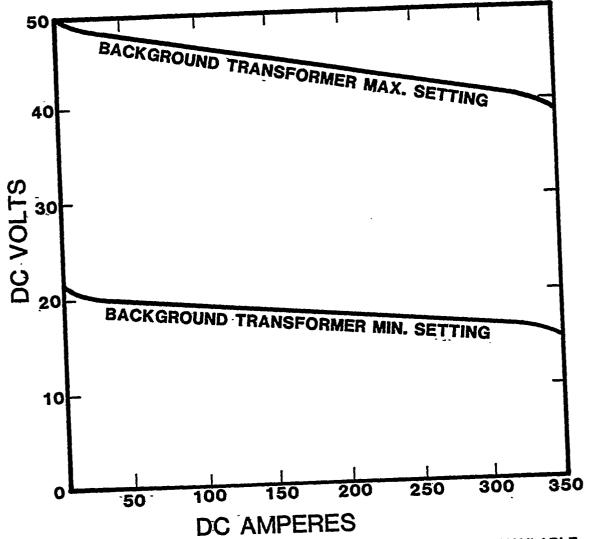
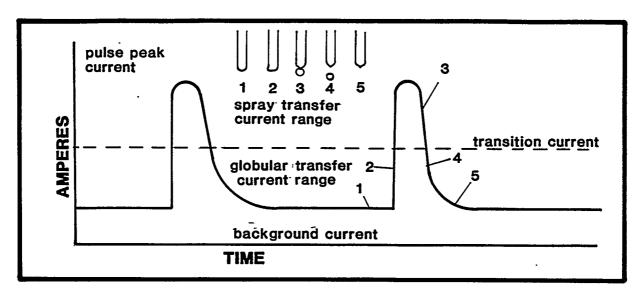


FIGURE 6
AIRCO MODEL PA-3A PULSED ARC WELDING MACHINE



NOTE: A LOWER RANGE FOR BACKGROUND VOLTAGES IS AVAILABLE BY A SECONDARY CONNECTION INSIDE THE PA-3A.

FIGURE 7
AIRCO PA-3A: VOLT-AMPERE CURVE



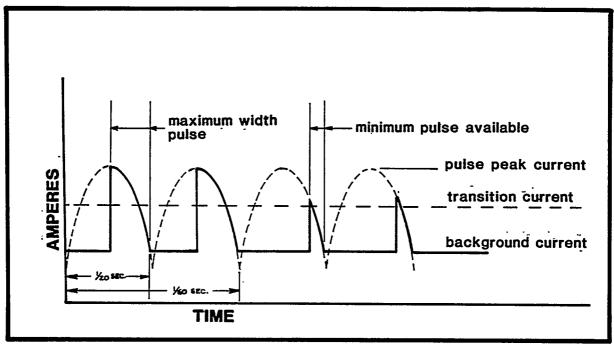
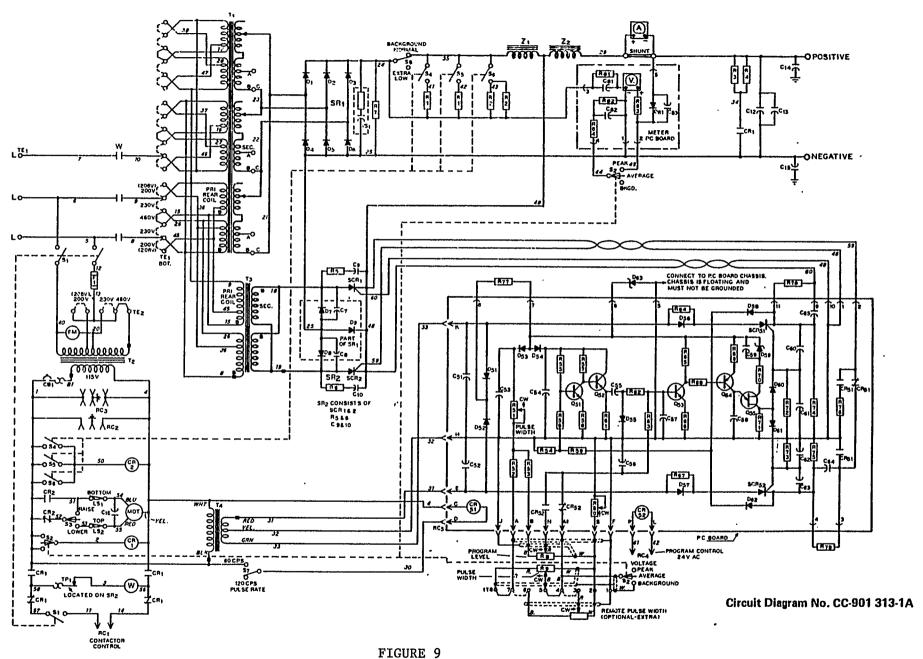


FIGURE 8
AIRCO PA-3A; METAL TRANSFER SEQUENCE



AIRCO PA-3A

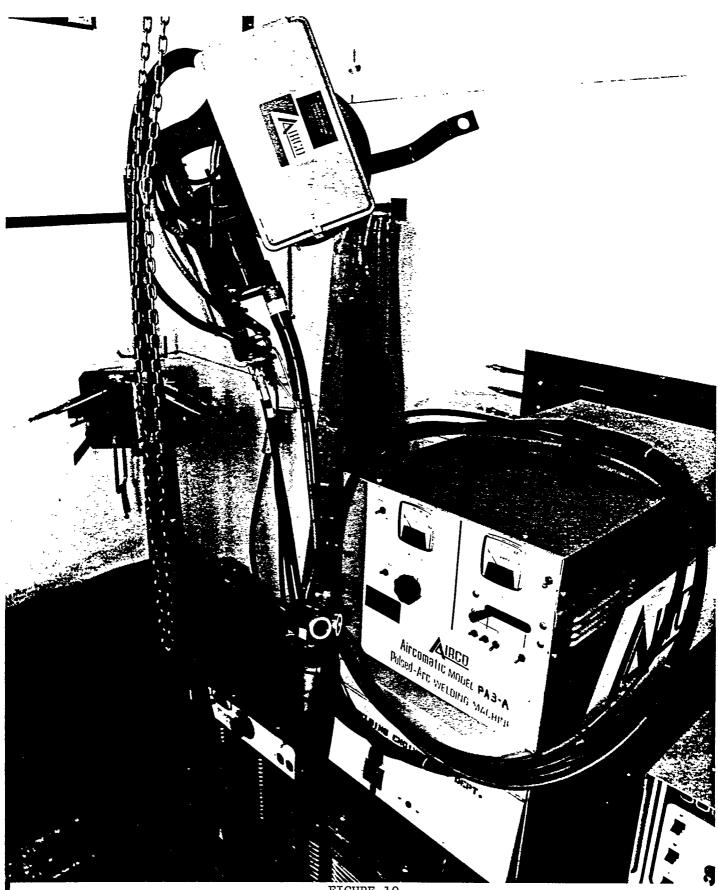


FIGURE 10
AIRCO PA-3A PULSE ARC WELDING POWER SOURCE, AHF-NP PULL FEEDER, AH35-C2 GUN

AIRCO PULSE ARC 350 WELDING SYSTEM

The Airco PA-350 Welding System consists of a constant voltage solid state welding power source, System 1 wire feeder, Aircomatic GMAW gun and remote control pendant.

The lightweight feeder is a dual drive roll unit, double insulated and totally enclosed for added operator and component protection. All wire feeder control circuitry is housed in the power source environmental compartment.

Standard features include slow run-in start, wire jog switch, built-in three-roll wire straightener, calibrated adjustable drive roll pressure and fixed pre- and post-flow timers. Wire speed is automatically controlled over a range of 40-800 inches per minute (i.p.m.) with standard hard and soft wire sizes .035 through 1/16 inch

The remote control pendant contains the synergic control potentiometer, arc length fine adjustment potentiometer, a manual wire feed speed adjust* potentiometer and a manual/automatic mode switch.

The welding gun included with the system is a new Aircomatic air-cooled gun. It is rated at 400 amps. CO_2 and is of single conduit design with heavy duty slip-on nozzle and quick disconnect fitting.

The welding meters and controls of the Airco PA-350 power source are listed as follows:

- DC ammeter CO-500 amperes).
- DC voltmeter CO-50 volts).
- Pulse process toggle switch (Up = CO₂)

(down = Argon/CO₂), and (middle= Pulse Mode).

 - Push buttons

#1 #2 #3 #4

CRATER WIRE

FILL DIAMETER MATERIAL GAS

in = on in - .035° in = SS in = purge

out = off out = .045" out - Ms out = weld

NOTE :

SS = Stainless Steel

MS = Mild Steel

- Crater current potentiometer. (applies only when #1 is pushed in).

Crater current (0-10)

Crater voltage (0-10]

Background (0-10)

- Power on/off switch.

Important features of this welding system are as follows:

"Electronic" wave shaping circuit in the CO, or Argon/CO, mode.

Pulsed spray and dip transfer process capabilities.

Single knob synergic control.

Crater fill.

Pre/post flow timers.

Solid state contactor.

Line voltage compensation.

Thermal overload protection and indicator light.

Environmentally protected cabinet design.

400 amp. gun (10 ft.).

Remote control pendant.

Voltmeter and ammeter.

115 VAC auxiliary power with $5\ \mathrm{amp.}$ circuit breaker fuse (0.5 kva) and dual receptacle.

Energy saving circuit.

Wire feeder:

- lightweight, totally enclosed.
- -wire sizes: .035 and .045 inch hard standard and 3/64 and 1/16 inch soft, optional 12 and 14 inch spools standard and 8 inch and 60 lbs. chipboard cores optional.

Slow run-in.

Wire job switch.

Built-in wire straightener.

Wire tip conditioning (stub burn off).

The Pulse Arc 350 system is a multi-purpose unit designed for pulsed spray transfer/"pulsed short-circuiting arc" welding.

Single control knob automatically establishes average current (wire feed speed) and average arc voltage for an optimum welding condition based on a given material, tire diameter and shielding gas. This system eliminates the need to individually set peak voltage/current, pulse frequency and background voltage current. The synergic characteristic of this control makes these selections automatically. The system consists of a power source, a totally-enclosed wire feeder, remote control pendant and a lightweight 400 amp. GMAW gun.

The power source output is controlled by a solid state control and power transistors which also compensate for line power input voltage fluctuations.

This system allows out-of-position welding with aluminum wires and is ideally suited for thin gauge material allowing increased welding rates without an increase in heat input resulting in subsequent weldment wax-page. In addition, excellent "pulse short-circuiting" welding maybe performed at outputs as low as 40 amperes, i.e. 3/64 inch diameter wire.

The standard system comes equipped to weld with .035 and .045 inch mild steel and stainless steel wires. With appropriate option, the system can weld with aluminum in 3/64 inch and 1/16 inch diameter wires.

The PA-350/System 1 feeder allows the use of one-to-two 1-2) size larger diameter electrodes. For example, 3/64 inch diameter aluminum alloy filler wires can be used in lieu of .035 inch or .030 inch diameters when welding a specific base material thickness such as .063 inch material thickness. This feature alone improves productivity because the use of larger diameter wire improves weld quality, offers better wire feeding characteristics and also reduces equipment down time.

The Airco PA-350 Welding System specification covering the power source, wire feeder, gun and physical data is illustrated in Figure 11. Also, a duty cycle chart, volt-ampere curve for pulsed spray arc, volt-ampere curve for short-circuiting mode and block diagram are illustrated in Figures 12, 13, 14, and 15. Also, background control settings and sequence of operations with and without crater fill are shown in Figures 16 and 17.

^ -

POWER SOURCE	PULSE SPRAY PROCESS	DIP-TRANSFER PROCESS			
	250.7. 0.26.77.14	000 7 0 07 5 77-1-			
Rated Output	350 Amps @ 36 Volts	280 Amps @ 27.5 Volts			
Duty Cycle	60%	60%			
Primary Input	3 Phase	3 Phase			
volts	230/460,60 Hz	230/460,60 Hz			
Primary Input Amperes	50/25	40/20			
KW-Input	18 20	14.4			
KVA-Input		16			
Maximum Open Circuit Volts	78	78			
Auxiliary Power (KVA)	0.5 @ 115 VAC	0.5 @ 115 VAC			
WIRE FEEDER					
Feed Type	Push				
Wire Sizes:					
Hard	0.035 inch (0.889 mm) Standard				
	0.045 inch (1.14 mm) Standard				
soft	3/64 inch (1.19 mm)				
	1/16 inch (1.58 mm)				
Feed Rate	40 to 800 ipm (1.02 to 20.5 mpm)				
Spool Size	12 and 14 inch standard				
-	8 inch and 60 lb. Chipboard	cores optional			
GUN					
a 1'	- 1				
Cooling	Air				
Gooseneck Angle	45°				
Rated 60% Duty Cycle	400				
(DCRP) Amps: CO ₂	400				
Argon	360				
Conduit Length	10 feet (3.04 m)				
PHYSICAL					
Net Weight System	420 lbs. (189 kg)				
Shipping Weight System	445 lbs. (201 kg)				
Height (Power Source)	27-1/4 inches (69 cm)				
Width (Power Source)	19-1/4 inches (49 cm)				
Depth (Power Source)	39 inches (99 cm)				
Height (Wire Feeder)	12-1/2 inches (32 cm)				
Width (Wire Feeder)	8 inches (20 cm)				
Depth (Wire Feeder)	19 inches (48 cm)				
DESCRIPTION IS INCIDENCE (10 SM)					
Pulse Arc 350 Power Source/Feeder/Gun/Remote Control Pendant					

FIGURE 11

230/460, 3 phase, 60 Hz

AIRCO PA-350 WELDING SYSTEM SPECIFICATION

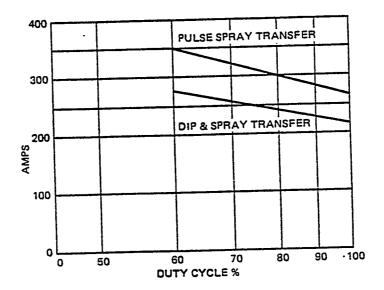


FIGURE 12
DUTY CYCLE CHART
AIRCO PA 350

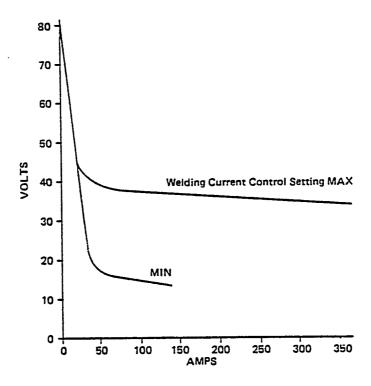


FIGURE 13

VOLT - AMPERE CURVE

PULSE SPRAY ARC

AIRCO PA 350

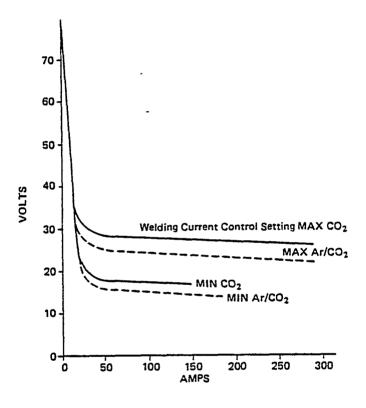


FIGURE 14

VOLT - AMPERE CURVE

SHORT CIRCUITING ARC

AIRCO PA 350

										Percen	it othe:	r ^s
ASTM/AWS 5.10	Si,	Fe,	Cu,	Mn,	Mg,	Cr,	Ni,	Zn,	Тi,	eleme		Al, ^D
Classification	percent	percent	percent	percent	percent	percent	percent	percent	percent	each b	total	percent
ER 5356	0.25	0.40	0.10	0.05-0.20	4.5 - 5.5	0.05-0.2	20 –	0.10	0.06-0.20	0.05	0.15	Remaind ϵ
ER 5556	0.25	0.40	0.10	0.50-1.0	4.7-5.5	0.05-0.	20 -	0.25	0.05-0.20	0.05	0.15	Remainde

NOTES :

- 1. Single values shown are maximum percentages, except where a minimum is specified.
- 2. Analysis shall be made for the elements for which specific limits are shown. If, however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that these other elements are not in excess of the limits specified for "other elements."
 - a. Beryllium shall not exceed 0.0008 percent.
 - b. The aluminum content is the difference between 100.00 percent and the sum of all other metallic elements present in amounts of 0.010 percent or more each, expressed to the second decimal before determining the sum.

FIGURE 25

ASTM/AWS 5.10 SPECIFICATION FOR ALUMINUM AND ALUMINUM ALLOY BARE WELDING RODS & ELECTRODES WELDING FILLER WIRE CHEMICAL COMPOSITION REQUIREMENTS 1, 2

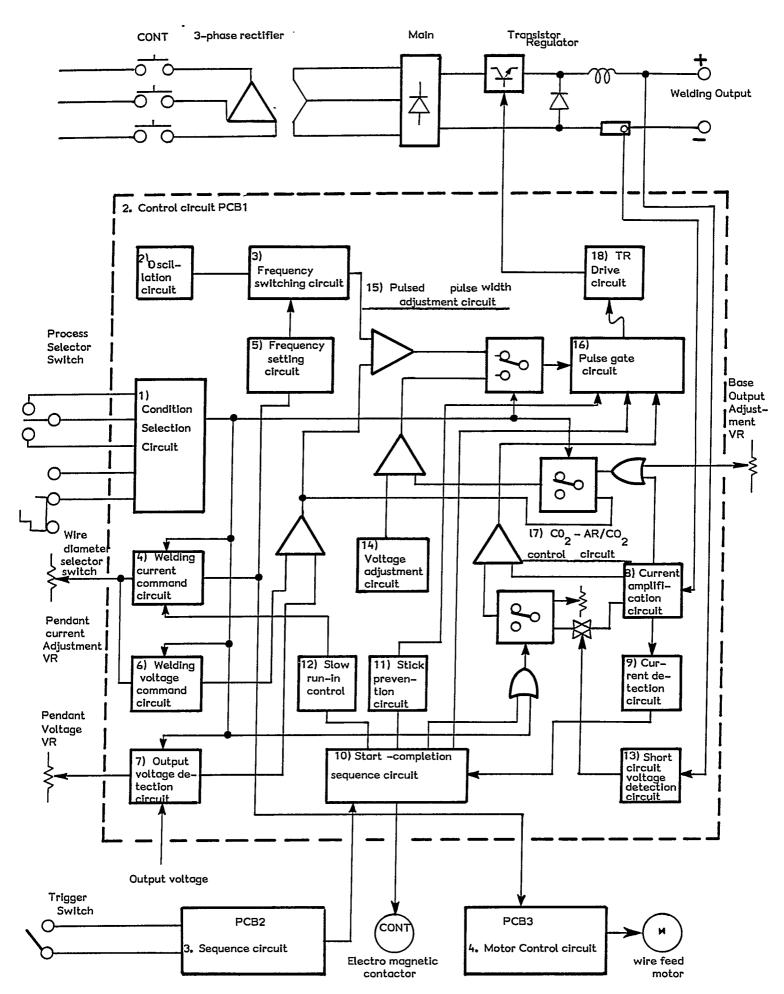


FIGURE 15

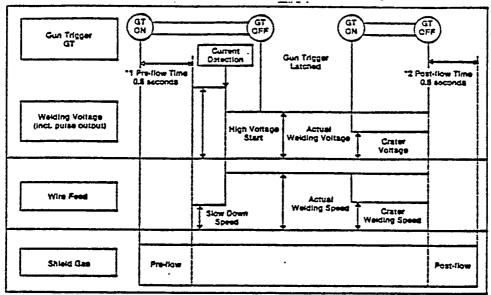
BACKGROUND CONTROL SETTING	CURRENT WAVEFORM	REMARKS
0 -2	W/W/W/W	Full spray power, crisp arc, narrow arc Pulse mode transfer characteristics fully displayed.
2-7	M & M & M & M & M & M & M & M & M & M &	Softer arc. less concentrated (<150A) Use < 10% CO ₂ for good transfer
7-10	Market Market Market	Soft arc, wide column spray transfer difficult below 200A. Use < 10% CO ₂ for good transfer.

FIGURE 16

AIRCO PA 350: BACKGROUND CONTROL SETTINGS

Sequence of Operation with Crater Fill

- 1. Initial squeeze of gun trigger activates gas pre-flow, slow run-in, latches gun trigger, then welds at set parameters.
- 2. Second squeeze of gun trigger activates crater fill program; releasing trigger breaks arc. supplies gas post-flow.

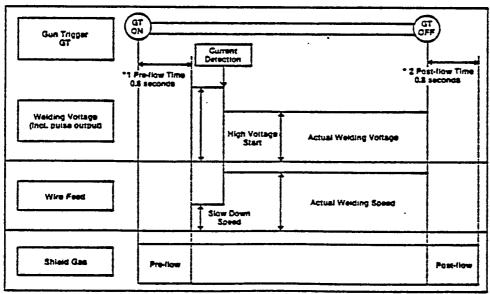


*1: 0.8 seconds when pre-flow is "ON," and 0 seconds when pre-flow is "OFF" at delivery,

"2: 2.4 seconds when were material selector switch is set to "stainless steet."

Sequence of Operation without Crater Fill

- 1. Squeezing gun trigger activates gas preflow, slow run-in, then welds at set parameters.
- 2. Releasing trigger breaks arc. supplies gas post-flow.



"1: 1 second when pre-flow is "ON." and G seconds when pre-flow is "OFF" at delivery.

*2: 2.4 seconds when wire material selector switch is set to "Stainless steet."

Welder acceptance of the Airco PA-350 prompted the following comments:

- Substantial reduction in spatter.
- Excellent weld cleaning action.
 - Pulsed frequency that is optimum for the welding current is automatically programmed, e.g. at 150 amperes approximately 150 pulses per second (PPS).
- The "pulsed short-circuit" frequency does not vary in extreme, i.e. consistent small droplet arc transfers.
- The "pulsed short-circuiting" arc has consistent short-arc lengths 2-3 times wire diameters.
- The welding arc is stable because a closed loop electronic feed-back system apparently is constantly monitoring the welding current/voltage and controlling it consistently and reliably to enable small molten droplets to transfer from the wire tip to the weld puddle.
- The Binzel torch is a wire push type gun. It is light and air cooled and eliminates operator fatigue when compared with the much heavier Airco water cooled AH 35-C2 pull gun.
- A simple integrated single dial sets the welding condition requested. A remote pendant controls and adjusts the pulse frequency, pulse width, background voltage and peakvoltage automatically. Heat input is regulated by the current-control potentiometer on the remote pendant.
- The stable pulsed spray arc and the "pulsed short-circuiting" arc mode offers out-of-position, one-side, full penetration welds from .063 inch through .125 inch thicknesses in 5000 series aluminum alloys.

The original plan was to use the Airco PA-3A power source to generate our benchmark (base line) information relative to welding techniques and test data. However, during the course of this project, the Airco PA-3A malfunctioned and while this unit was being repaired we discovered the unusual "pulsed short-circuiting' mode on the Airco PA-350. At this point in time, the Airco PA-350 power source, System 1 wire feeder, and Aircomatic 400 ampere torch was substituted to determine and establish the basic objectives of this project.

GILLILAND CV 600 FI-PA

The Gilliland CV 600 FI-PA is $a\ 600$ ampere constant voltage DC gas metal arc welding power source which can provide pulse in 60 and 120 pulses per second. It also functions in the standard GMAW mode without pulse and short-circuiting modes. Gilliland appears to have taken their basic CV 600 power source and added the capabilities for pulse.

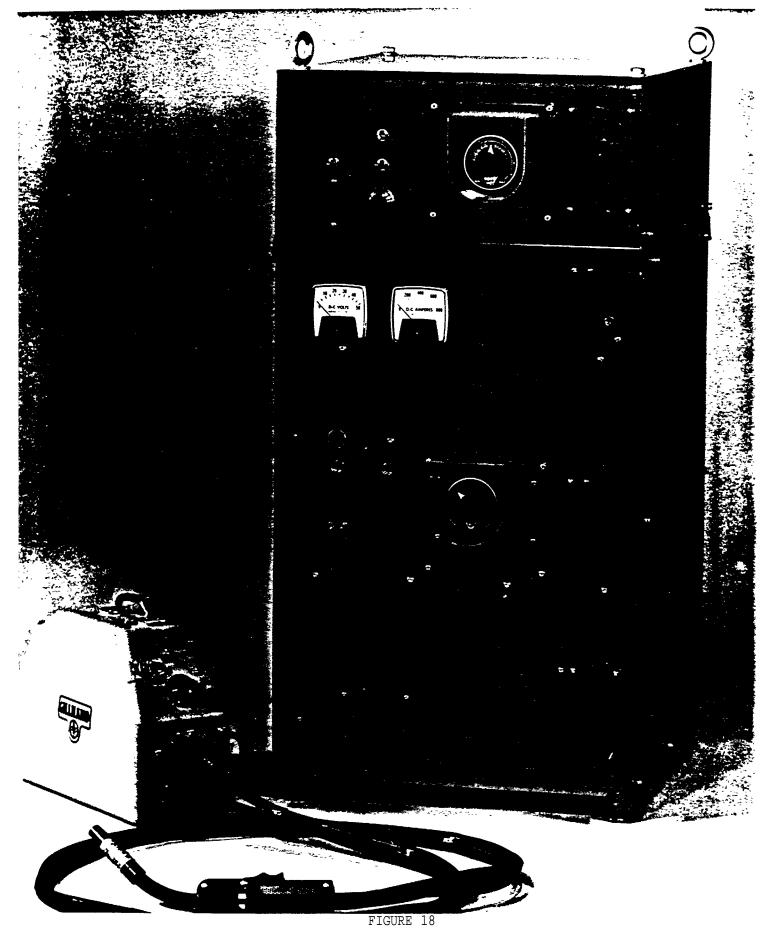
There is a two position toggle switch for either 120 or 60 pulses per second and also a similar switch for pulse or standard constant voltage mode. A third toggle switch is a "stabilizer" on/off switch which apparently provides proper induction and arc stability. Also, there is a fourth "energizer" on/off toggle switch. A "test" push button provides open circuit voltage readings.

The use of electronically controlled SCR'S is the method applied for control of pulse rates.

A single pulse voltage knob ranging from 0.10 scale is a simple way to set pulse voltage higher or lower. The other 0-10 scale knob controls standard voltage ranges. This power source is extremely easy to set-up for welding in the pulse mode.

The Gilliland CV 600 FI-PA pulse arc GMAW welding power source and the portable 8 inch spool wire feeder are illustrated in Figure 18.

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MALCOLM T. GILLILAND CV 600 FI-PA, PULSE ARC WELDING POWER SOURCE, FEEDER & GUN

MILLBR PULSTAR 450

The Miller Pulstar is a 450 ampere constant potential DC gas metal arc welding power source which can provide pulsed as well as the standard and short-circuiting arc modes. Miller Electric Manufacturing Company has taken their basic Deltaweld 450 and redesigned it to a star connection and added the capabilities for pulsed as well as short-circuiting and spray gas metal arc processes.

A three position welding mode selector switch can be set for standard operation spray or short-circuiting process and also 60 and 120 pulses per second of pulsed current. In the pulse mode, background voltage and peak amperage can be controlled at the power source or remotely via pendant control.

The features of the Miller Pulstar 450 are as follows:

Three position mode switch for standard operation (no pulsing), and 60 and 120 pulses per second of pulsed current.

Arc sustainer.

Weld ammeter swithh, selects average or peak reading.

Background voltage control.

Peak amperage control.

Solid state contactor.

Line voltage compensation (+10%).

Low voltage on/off push button.

Power failure reset.

115 volt duplex receptacle.

Volt and ammeters.

Standard/remote contactor control switch.

Standard/remote output control switch.

The Miller Pulstar 450 power source specification and physical information are shown in Figure 19. The volt ampere curve and the duty cycle chart are shown in Figures 20 and 21.

On the Miller Pulstar 450 field test power source unit, the following items are visible:

Remote contactor control.

115 volts AC receptacles (3).

DC voltmeter (0-100 volts).

DC ammeter (0-600 amperes).

Switch to set for 120 pps, 60 pps and standard (no pulse).

Power on/off buttons.

Remote output control (remote vs. standard).

Remote contactor control remote vs. standard).

Peak amperage adjustment potentiometer (200-550 amperes).

Background voltage adjustment (minimum-38 volts).

* * * * * * * * *

PULSE GMAW: POWER SOURCES: ATTRIBUTES

A chart covering the basic attributes of each of these four pulse GMAW power sources discussed previously is illustrated in Figure 22. Also, the pulse GMAW power sources and feeders used in this project are shown in Figure 23.

	Rated Welding Current		Max. Open-	Input At Rated Load Output 60 Hz. Three-Phase								
	Amperes Voltage		Circuit		Amperes At					Overall	Weight	
Model	100% Duty Cycle	Range	Voltage	200V	230V	460V	575V	kva	kw	Dimensions	Net	Ship
450 Ampere	450 @ 38 Volts	14-38	80	81	70	35	28	28	23	Height - 27-1/2 in. (699 mm)* Width - 22-1/4 in. (565 mm) Depth - 35-3/4 in. (908 mm)	447 lbs. (208 kgs.)	472 lbs. (214 kgs.)

^{*}Add 2-3/4 in. (70 mm) for lifting eye.

FIGURE 19

MILLER PULSTAR 450 WELDING POWER SOURCE SPECIFICATION

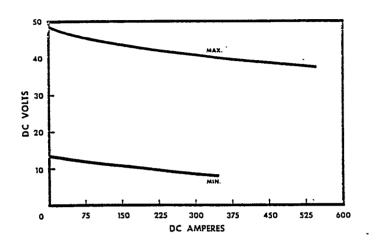


FIGURE 20
MILLER PULSTAR
VOLT AMPERE CURVE

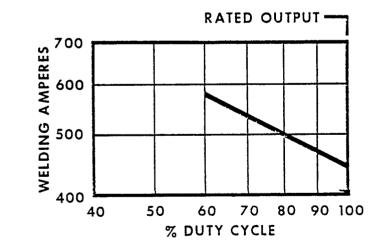


FIGURE 21

MILLER PULSTAR

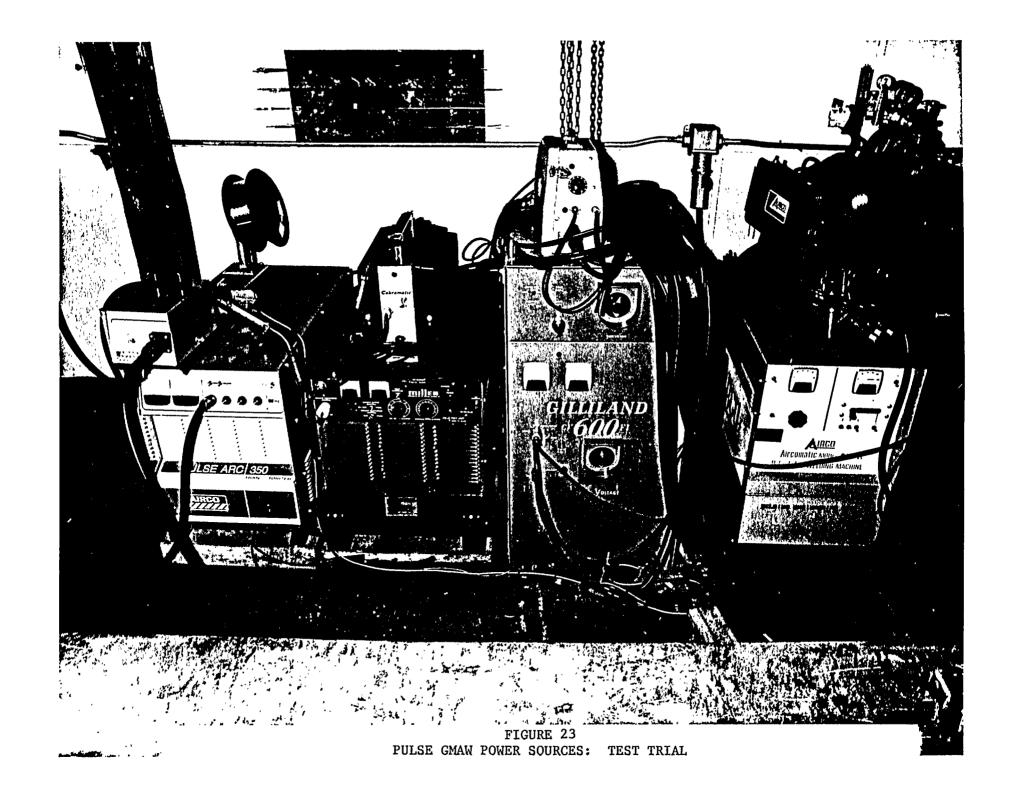
DUTY CYCLE CHART

	HANUF	CTURE	R		AIRCO			AIRCO	MILLER	GILLILAND
	MODEL	NO.			PA-3A		PULSE	E ARC 350	PULSTAR	CV600 FI-PA
										
	MODE			P	ULSE MODE		Pulse Mode Dip/Spray Mode		PULSE & STANDARD MODE	PULSE-STDDIP/SPRAY
	Rated	Curre	ıt	300			350	280	450	600
	Rated	Volts		30			36	275	38	40
	Duty Cycle			···	100%		60%	60%	100%	100%
	Maxim	ım OCV		76 (pea	k) 50 (bacl	(ground)	78	78	80	78
	Pulse	Rate	(pps)		60/120		50-250 ррв	Pre-programmed	60/120	60/120
								Electronically	Electronically	Electronically
								Controlled	Controlled	Controlled
	Type			Rec	tifier/SCR		Rectifier	/Transistor	SCR	SCR-SCR
	Contro	1 Met	nod	Dual Power S	ource (pulse	source	Transistor Swi	tching Regulator	Electronically Controlled	Electronically Controlled
				is electron	ically contr	colled			SCR s	SCR¹s
	Single	Knob	Control	N/A			Sta	ındard	N/A	Optional
	Processes			Pulse/Spray			Pulse/Dip-T	ransfer/Spray	Spray/Dip-Transfer/Pulse	Pulse/Dip-Transfer/Spray
	Ammeter			Standard (avg.)			Standa	ird (Avg.)	Standard (avg./Peak Switch)	Standard (Avg.)
	Voltme	ter		Standard (Peak/Avg/Backgr'd Sw.) Standard Optional			Standa	ird (Avg.)	Standard (avg.)	Standard (Ayg.)
····	Pulse	Width	Control (Peak Yolt.)				Electronica	11y Programmed	Peak Current Adj.	Electronically Controlled
	Remote	Cont	:01				Standard w/voltage trim		Optional	Standard
							and integrated single knob control			
	Energy	Sayi	g Circuit		N/A		Sta	ındard	N/A	Optional
	Arc St	staine	er	X-	Low Mode		N	I/A	Standard	Standard plus Stabilizer
	Backgi	ound \	/olt Range	2	0 to 47		Electronica	lly Programmed	14 to 38	12 to 38
	Peak \	olts	lange		20-80		Electronica	11y Programmed	Maximum OCV-80	Electronically Programmed
	Wire I	eed (Current) Control		N/A		Electronica	11y Programmed	N/A	Electronically Controlled
	Fault	Light			N/A		Sta	ndard	N/A	Optional
· · · · · · · · · · · · · · · · · · ·	Materi	al Sw:	tch		N/A		Stainless St	eel/Mild Steel	N/A	Optional
	Wire S	ize S	itch		N/A		0.03	5/0.045	N/A	Optional
	Line Yolt Compensation 115 Yolt Duplex Solid State Contactor		S	tandard		Sta	ndard	Standard	Standard	
			Standard (1 KYA) N/A			Standar	d (.5 KVA)	Standard (1 KVA)	Standard (1 KVA)	
						Sta	ndard	Standard	Standard	
	Gas Sc	lenoi			N/A		Standard (w/p	urge/weld switch)	N/A	Standard (w/Pre/Post Timing)
Cale.	REVISED	DATE	GMAW PULSE ARC POW	R SOURCE:						
Teac Chà			ATTRIBUTE CHA	ART						

WE 005 3/83 TODD PACIFIC SHIPYARDS CORP.
SEATTLE DIVISION

DATA SHEET

FIGURE 22



5000 SERIES ALUMINUM ALLOY SHEET & PLATE

The 5000 series aluminum alloy is a non-heat treatable alloy. The major alloying element is magnesium (5% maximum). The addition of magnesium provides strength. Further strength is gained by cold working. Cold working or strain hardening is attained by stretching, rolling or drawing sheets or plates through dies, or other similar operation.

The 5000 series aluminum alloy sheet and plate temper and material thicknesses investigated in this program were as follows:

MATERIAL THICKNESS	ALUMINUM ALLOY <u>& TEMPER</u>
.063 inch	5086 H-32
.100 inch	5086 Н-32
.125 inch	5083 Н-323
.250 inch	5086 Н-116
.250 inch	5456 Н-116
.250 inch	5083 H-321
.500 inch	5086 Н-116
.500 inch	5456 Н-116
.500 inch	5083 Н-321

In the four digit system for aluminum and aluminum alloy, grouping indicates the alloy group. This is as follows:

DESIGNATION FOR ALLOY GROUPS

METAL	ALUMINUM	ASSOCIATIO	ON NUMRER
ALUMINUM 99% MIN. AND GREATER	₹	l xxx	

MAJOR	ALL	OYING	ELEMEN	TS		
COPPER	3			2	XXX	
MANGAN	IESE			3	XXX	
SILIC	ON			4	XXX	
MAGNES	SIUM			5	XXX	
MAGNES	BIUM	AND	SILICON	6	XXX	
ZINC				7	XXX	

ALUMINUM ASSOCIATION TEMPER DESIGNATION SYSTEM

- -0 Annealed; Applies to softest temper (Wrought products).
- -H Strain Hardened, Strength increased by strain hardening (Wrought products).

The -H is always followed by two or more digits. The first digit indicates the specific combination of basic operation as follows:

- -H Strain hardened only. The number following this designation indicates the degree of strain hardening.
- -H2 Strain hardened and then partially annealed.
- -H3 Strain hardened and then stabilized.

The second digit following the designation -Hi, -H2, and -H3 indicates the final degree of strain hardening. Tempers between -0 (annealed) and 8 (full hard) are designated by numerals 1 through 7, e.g. -H12 = 1/4 hard, -H36 = 3/4 hard, -H38 = full hard.

The third digit indicates a variation of a two-digit H temper, i.e. amount of strain applied. It is used when the degree of temper control or the mechanical properties are different. -H323, for example, applies to aluminum-magnesium alloys (5000 series) specially designed for acceptable resistance to stress corrosion cracking.

The 5000 series aluminum alloy sheet and plate materials have experienced wide usage in marine fabrication. This series is the most widely used in marine service.

5083 ALUMINUM ALLOY

This alloy is a strong weldable alloy used primarily in armor and cryogenic applications. There are no restrictions for use in marine environment but it is not recommended to be used for applications involving temperatures above 150F.

5086 ALUMINUM ALLOY

This weldable alloy is generally used in hull and superstructure and meets general marine fabrication requirements. There are no restrictions for use in marine environment but it is not recommended for use in applications over 150F. 5086 H-116 aluminum alloys are used in hull fabrication.

5456 ALUMINUM ALLOY

This weldable alloy offers the highest strength and is used primarily for hulls, superstructures and special purpose vehicles where high strength-to-weight ratio is desired, e.g. air cushion vehicles and hydrofoils. The 5456 H-116 aluminum alloy is used for hull applications. This alloy is not recommended for use in application over 150F but otherwise there are no restrictions for use in *marine* environment.

Typical mechanical properties data for 5000 series aluminum alloy sheet and plate per U.S. Federal Specifications vs. The Aluminum Association are compared in Figure 24.

. .

SHEET & PLATE	ALUMINUM			MELTING PANCE P	ULTIMATE TE TENSILE STR			YIELD ST 0.2% O	FFSET		ELONGAT	ION	BRINELL
MATERIAL SPECIFICATION	ALLOY DESIGNATION	TEMPER	THICKNESS	RANGE F (APPROXIMATE)	ALUMINUM		-250	ALUMINUM		-250	ALUMINUM		HARDNESS 500 Kg I.OA
SPECIFICATION	DESIGNATION	TEFIFER	Interness	(AFFROXIFIATE)	ASSOCIATION	MIN	MAX	ASSOCIATION	HIN	HAX	ASSOCIATION	QQ-A-250	10 mm BALL
QQ-A-250/6	5083	0	1/8"	1070-1185	42000	40000	51000	21000	18000	29000	22	16	67
	5083	H-321	1/4";1/2"		46000	44000	<u> </u>	33000		<u></u>	16		82
	5083	H-323	1/8"		47000	45000	54000	36000	34000	44000	10	8	84
QQ-A-250/19	5086	0		1085-1185	38000	35000	42000	17000	14000		22-30	16	60
QQ-A-250/7	5086	H-32	.063"/0.10"		42000	40000	47000	30000	28000		12-16	8	72
										•			
QQ-A-250/19	5086	н-116	1/4";1/2"		42000	40000	77	30000	28000	,	12-16	10	72
										i			
QQ-A-250/20	5456	0		1055-1180	45000	42000	53000	23000	19000		24	16	70
QQ-A-250/20	5456	H-116	1/4";1/2"		51000	46000		37000	33000		16	10	90
													-
			·									*****	
											•		
							[

Calc.		REVISED	DATE	TYPICAL BASE METAL PROPERTIES OF	
Trac				5000 SERIES ALUMINUM ALLOYS	
CM				THE ALUMINUM ASSOCIATION va. FED SPEC.	
Appr.				TODD PACIFIC SHIPYARD CORPORATION	
Appr.				SEATTLE DIVISION	

FIGURE 24

DATA SHEET

WE 004 3/83

ALUMINUM ALLOY FILLER WIRES

In general, for welding 5000 series aluminum alloy sheet and plate, the Plans (Drawings) will, unless otherwise specified, permit the fabricator to use interchangeably ER 5183, 5356 or 5556 per ASTM/AWS 5.10, "Specification For Aluminum and Aluminum Alloy Bare Welding Rods and Electrodes." The prefix ER is used by AWS to denote "Electrode/Rod" to cover both the gas metal arc welding GMAW or the gas tungsten arc welding GTAW process.

For this project, only the ASTM/AWS ER 5356 and 5556 aluminum alloy bare wires in 12 inch diameter spools (10-12 lbs.) were used, i.e. ER 5183 filler wires were not available Without schedule impact. ASTM/AWS 5.10 requirements covering chemical composition for ER 5356 and 5556 are shown in Figure 25.

Burn off characteristics of 5356 aluminum alloy filler wires are illustrated in Figure 26.

The weld is a composite or alloy of the filler material and the base material. This composite largely determines the mechanical properties of the weld. Also, the gas metal arc process does leave an annealed condition weld area. Weld joint configuration, weld filler wire types and welding techniques are other variables that must be considered. High. magnesium gas metal arc filler wires such as ER 5183, 5356 and 5556 generally produce strong ductile welds.

Usually the "as welded" tensile strengths of the 5000 series aluminum-magnesium alloy welds are equal to the strength of the annealed base material. The only way to strengthen "as welded" tensile strength in 5000 series aluminum is to cold work, e.g. roll-planishing, which is not practical in a shipyard setting.

All aluminum alloy filler materials when opened were kept in a dry warm storage box. This is illustrated in Figure 27. Only Alcoa "Almigweld" aluminum alloy filler wires were utilized.

1

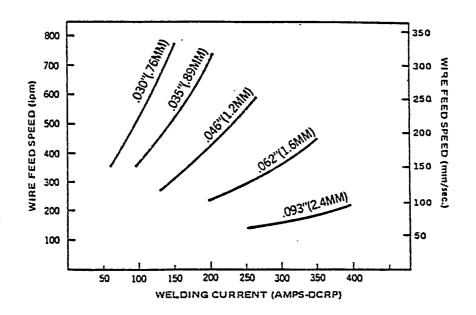


FIGURE 26

BURN-OFF CHARACTERISTICS

5356 ALUMINUM WIRE



WELD JOINT DESIGNS

Square butt weld joint designs were used on the .063, .10, and .125 inch thick 5000 series aluminum alloy sheet test piece parts. See Figure 28 for square butt weld joint design.

The .250 inch and the .500 inch thick aluminum alloy plates were machined with "J" type weld joint designs. Initially, the dimensioning of the root face was .075 inch and .100 inch for the .250 and .500 inch material thicknesses as illustrated in Figure 29. The final or preferred joint design was based primarily on the consistency and reliability towards attaining out-of-position, one-side, full penetration welds. See Figure 30, which illustrates the "J" joint configuration used on 1/2 inch material thicknesses. The 1/16 inch width of flat dimension between the centerline of the weld joint and the tangent point of the .125 inch radius was shortened as required to provide acceptable weld bead reinforcements. This is illustrated on the individual Welding Procedure Qualification Test Summary pages further in the text.

A high speed end mill cutter head was used on a Bridgeport Series 1 type mill to machine the "J" type joints on the longitudinal side (12" length) of the 8 inch x 12 inch test piece parts. See Figure 31.

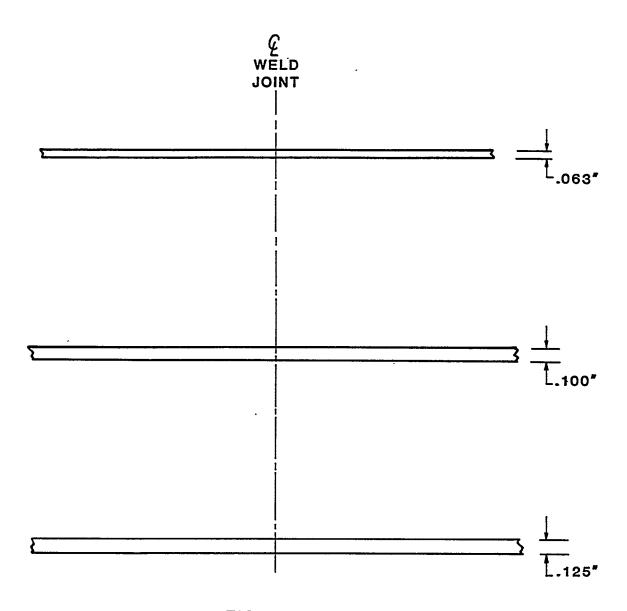
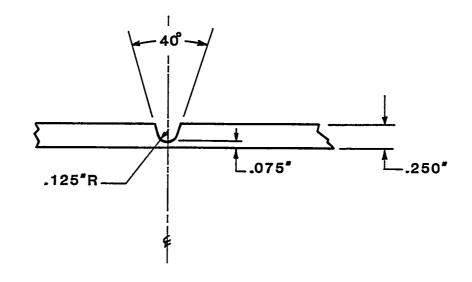


FIGURE 28

BUTT WELD JOINT CONFIGURATION FOR .063 , .100 , AND .125 INCH THICK 5000 SERIES ALUMINUM ALLOYS



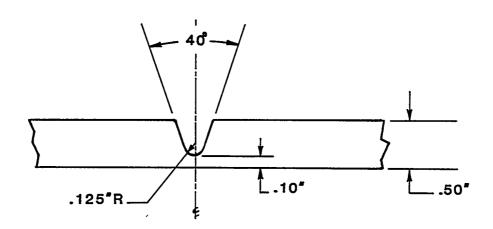


FIGURE 29

WELD JOINT CONFIGURATION FOR .250 AND .500 INCH THICK 5000 SERIES ALUMINUM ALLOY PLATES

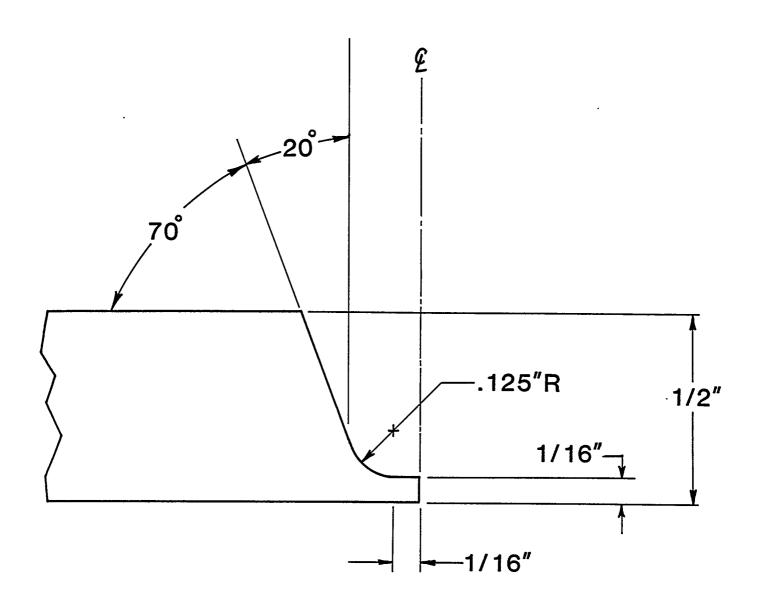


FIGURE 30
"J" JOINT DESIGN FOR 1/2 INCH THICK PLATE

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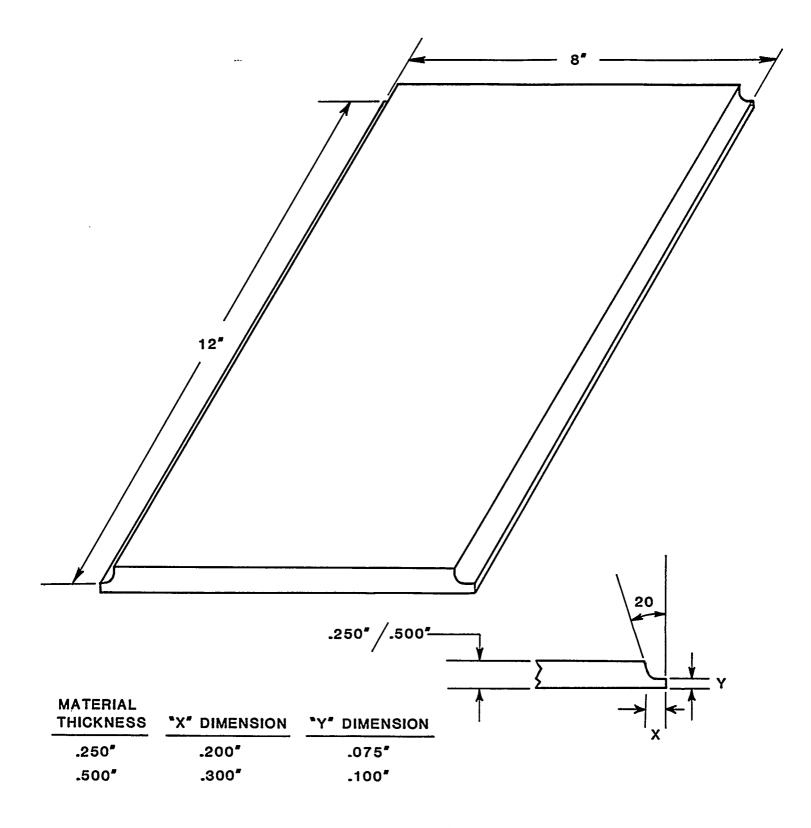


FIGURE 31

SHIELDING GASES

The choice of weld shielding gas or combinations thereof for manual pulsed gas metal arc welding were argon, helium, argon/helium *or* argon oxygen mixtures. The gas selection chart for these gases is illustrated in Figure 32.

		SHI ELDING GAS						
BASE METAL	GMAW MODE	ARGON	HELIUM	ARGON HELIUM MIXTURES	ARGON OXYGEN			
ALUMINUM	SHORT-CIRCUITING ARC MODE OF METAL TRANSFER	х	х	X (75% HELIUM 25% ARGON)				
ALUMINUM	PULSES SPRAY ARC MODE OF METAL TRANSFER	х	х	х	(OXYGEN) 0.1%-1.0%			

FIGURE 32

GAS METAL ARC SHIELDING GAS SELECTION CHART

ARGON SHIELDING GAS

Argon is a colorless, odorless, inert gas comprised of heavy single atoms having a molecular weight of 39.948. It will not combine with any other element to form molecular or compounds. Argon gas is heavier than air. The density of argon is 0.111 lbs./ft.³. Argon is a monatomic inert gas with low voltage gradient and its chief characteristic is that it sustains a stable welding arc. Argon is a poor heat conductor and produces an extremely high current concentrated welding arc core resulting in a weld penetration pattern which is deep in the center and shallow around the edges of the weld nugget.

Argon is used generally for welding aluminum in the flat welding position.

HELIUM SHIELDING GAS

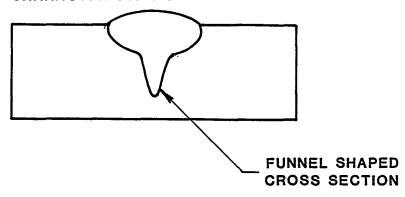
Helium is also a monatomic colorless, odorless inert gas. The molecular weight of helium is 4.0026. Helium gas is lighter than air or argon, i.e. molecular weight of air is 28.96. Helium is 1/10 the weight of argon. Helium is characterized by a high voltage gradient and offers more wattage in the welding arc when compared with argon. Helium is a high heat conductivity gas, and when used with welding results in a broad even penetration weld cross section. See Figure 33 illustrating the effects of argon and also helium gas shielding on weld nugget penetration and shape.

ARGON/HELIUM COMBINATIONS

The 75% helium/25% argon shielding gas mixtures provide the advantages of both gases: a broad, even and deeper weld nugget cross section. Figure 34 illustrates the weld penetration geomentry when 75% helium/25% argon shielding gas is used for manual gas metal arc welding. Helium/argon gas mixtures when used with gas metal arc welding take advantage of the favorable characteristics of both gases, e.g. high heat input, deep penetration, low spatter, stability, good radiographic weld quality, good weld bead width/depth ratio. Argon/helium mixtures are widely used for out-of-position radiograph quality welds. Helium rich mixtures help achieve significant benefits from the helium. The type of gas(es) to be used for shielding should be based on which gas or gas combinations provide the greatest overall advantages for a specific application.

ARGON

CHARACTERISTIC: STABILITY



HELIUM

CHARACTERISTICS:INCREASED HEAT INPUT

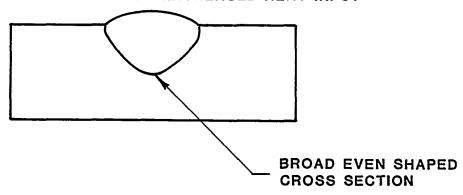
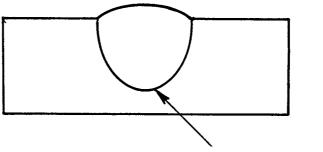


FIGURE 33
WELD PENETRATION SHAPE
ARGON AND HELIUM

HELIUM-ARGON MIXTURE

CHARACTERISTICS: GOOD WELD BEAD SHAPE



GOOD WIDTH/DEPTH RATIO CROSS SECTION

FIGURE 34

HELIUM-ARGON MIXTURE WELD PENETRATION GEOMETRY

The shielding gas used for this project was primarily limited to 75% helium/25% argon combinations. Argon gas was per MIL-A-18455 and helium gas was per Federal Specification BB-H-1168, Grade A.

The basic reason for the choice of 75% helium/25% argon combination shielding gas was because past experience had indicated that acceptable radiograph testing quality levels could be more readily obtained for all-position manual gas metal arc welding of 5000 series aluminum alloys. However, on .500 inch thick aluminum alloy material 100% helium shielding gas was utilized to make excellent welds. With the increased material thicknesses, it was felt that better sidewall fusion could be attained in the full penetration root passes as well as in the multiple fill passes.

In general, the 75% helium/25% argon shielding gas mixture, as well as the straight helium gases, were preferred because good width/depth ratio could be attained in the weld cross sections. This type of weld cross section with almost parallel side wall also offered less distortion, i.e. more balanced heat input.

MATERIAL PREPARATION

A cutting diagram was developed for 5000 series aluminum alloy sheet and plate materials ranging from 1/16 inch, .100 inch, .125 inch, .250 inch and .500 inch thicknesses and were all sheared into 8 inch x 12 inch piece parts to be butt welded on the 12 inch side to make 12 inch x 16 inch butt welded test panels. All the shearing of the test piece parts (8 inch x 12 inch) were done in either the Wysong and Miles Co., Model No. 1010 or the Cincinnati Inc., hydraulic shears. The rolling direction ("grain") was transverse to the weld joint centerline. A typical cutting diagram is illustrated in Figure 35.

All aluminum alloy sheet material up to and including .125 inch thicknesses were draw filed with a bastard vixen type file so that all sharp edges, shear marks, and lamination that could cause deleterious effects in the weld were completely removed. Mechanical sanding, chipping, machining, routing are other alternative methods used for weld joint preparation. See Figure 36.

Methyl-ethyl-ketone (MEK] was applied with a clean rag around the weld joint areas and surface to ensure that it was free of grease, oil, moisture, paint, shop soil, or other harmful matter. It should be pointed out that MEK may not be approved for use in confined, closed areas, i.e. alternate approved solvents should be used in production applications such as Dow Chemical Chlorothene VG. Decreasing with an approved solvent prior to and after mechanical cleaning appeared best.

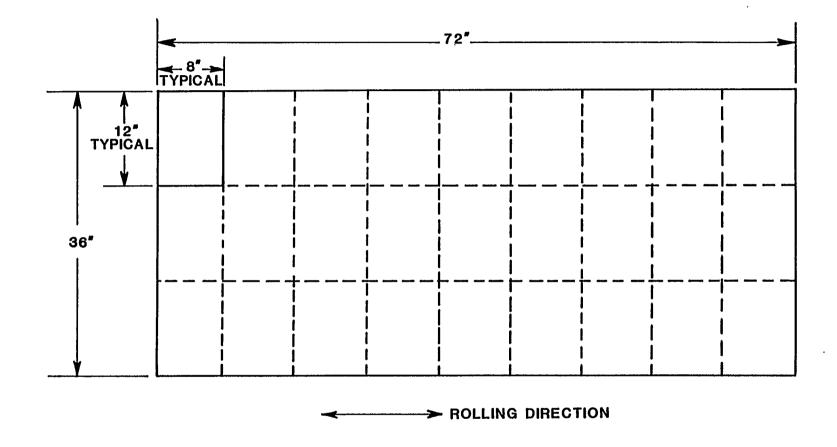
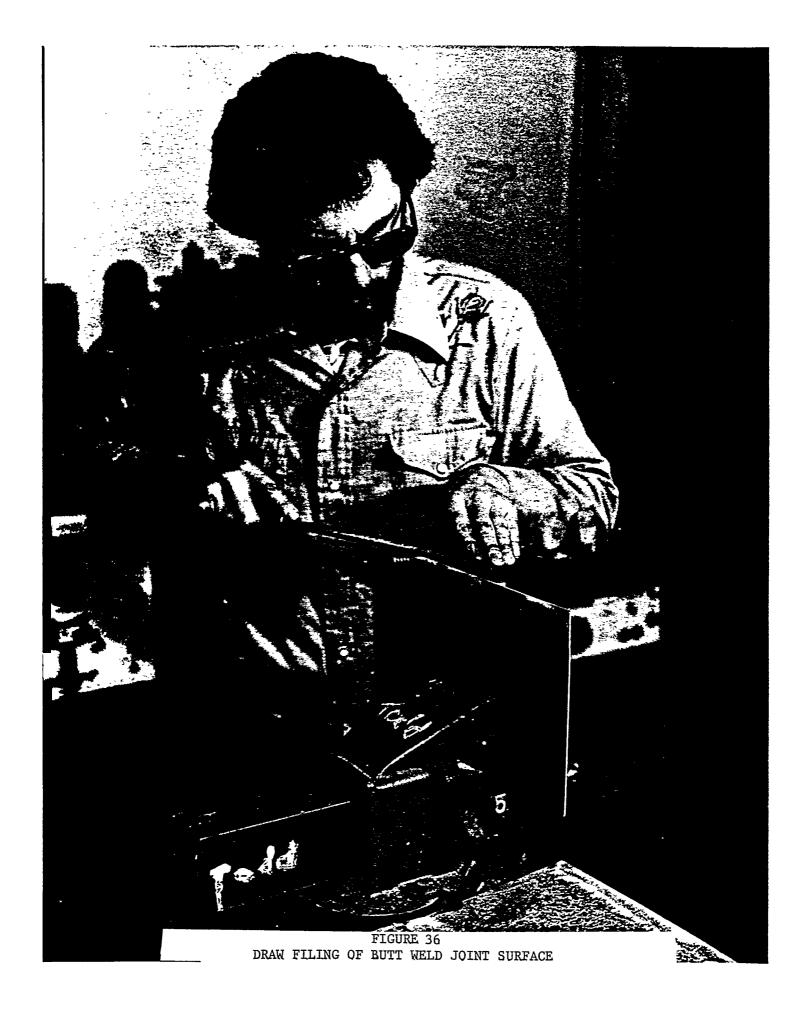


FIGURE 35

TYPICAL CUTTING DIAGRAM FOR 5000 SERIES ALUMINUM ALLOY SHEET AND TEST PLATES



Cleaning the test plate weld joint area with a portable disk grinder was done preferably with an open-coat disk of **80** grit aluminum oxide. This sanding disk removes heavy oxide film readily where stainless steel wire brushing appeared ineffective. See Figure 37.

Immediately prior to welding, the weld joint and areas adjacent to the weld joint were wire brushed with a clean stainless steel wire brush. This was done either with a hand held brush or power driven rotary brush. Stainless steel wire brush bristles were approximately .010 - .015 inch diameters. See Figure 38.

Whenever overnight delays in between assembling test piece parts and welding occurred, the weld test assembly was covered and wrapped with clean Kraft wrapping paper to keep off shop soil and dust. Care was taken to preclude the adhesive from adheing to the weld joint areas and causing subsequent weld contamination, i.e. no eight hour time limits were necessary.





WELD JOINT FIT-UP

Weld joint fit-up preferably should be metal to metal, i.e. zero gap. The maximum butt joint gap allowed anywhere over the length of the weld joint should be as follows:

MATERIAL THICKNESS(T)	MAXIMUM JOINT ROOT OPENING (GAP)				
up to .125 inch	1/4 Т				
.125 inch and thickner	.030 inch				

Weld joint fit-up requirements per NAVSEA 0900-000-1000/0001, "Fabrication, Welding and Inspection of Ships' Hulls," are as follows:

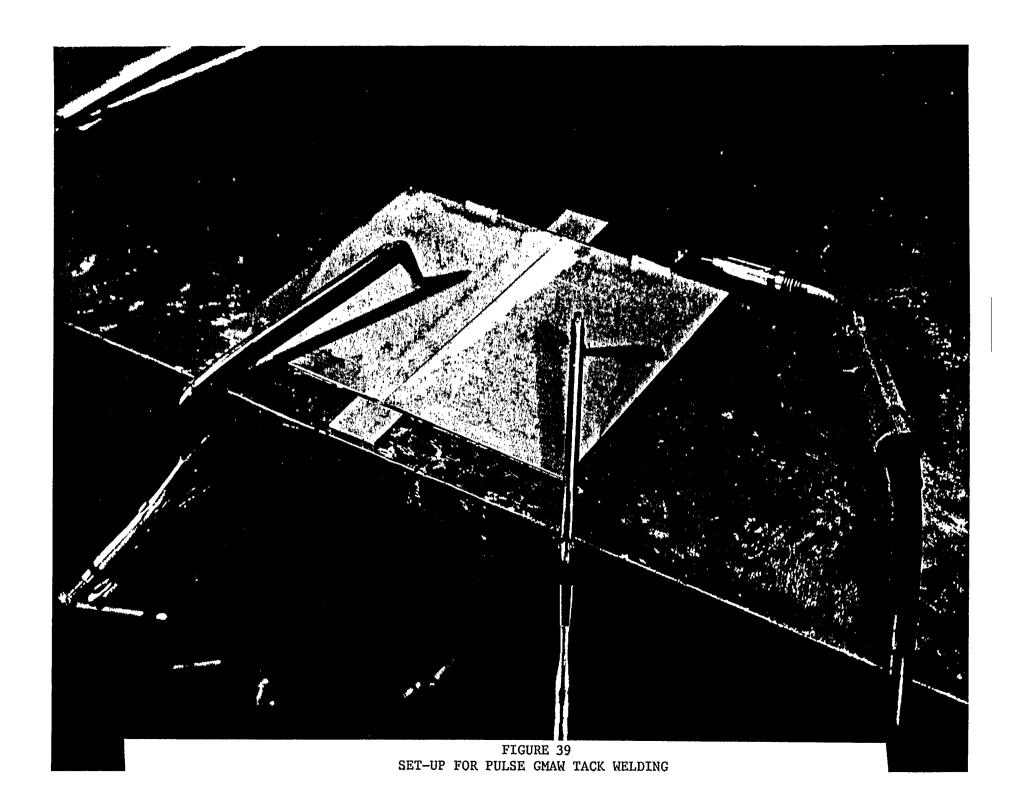
MATERIAL THICKNESS

less than .375 inch 1/16
.375 inch and thicker 1/8

Obviously, these requirements were written for stick electrode welding and are inadequate and not in consideration of the newer welding processes or thinner sheet materials.

All test piece parts were manual GMAW tack welded together with weld start and weld stop tabs. All the butt welds were made on the side opposite the tack welds, i.e. both butt and "J" groove weld joints. See Figure 39.

- -



WELDING TESTS

This section describes the various welding tests conducted to generate welding procedure specification qualification data per NAVSHIPS 0900-000- 1000/1, "Fabrication, Welding and Inspection Of Ship Hulls," and MILSTD-00248 (Ships), "Welding Procedure and Performance Qualification," for the out-of-position, one-side, full penetration manual pulsed gas metal arc welding of 5000 series aluminum alloy sheet and plate for marine fabrication.

The welding variables involved in this investigation covered the following:

1. 5000 series aluminum alloy base material type & temper,

5083 H-321

5083 H-323

5086 H-116

5456 H-116

2. 5000 series aluminum alloy sheet and plate thicknesses,

.060 inch

.100 inch

.125 inch

.250 inch

.500 inch

3. Filler wire alloy and diameters,

5356 aluminum alloy wires

5556 aluminum alloy wires

.030 inch diameter

.035 inch diameter

3/64 inch diameter

1/16 inch diameter

4. Shielding gas & combinations,

75% helium/25% argon

100% argon

5. Welding positions:

vertical-up
overhead
horizontal
flat

6. Welding power sources:

Airco PA-3A
Airco PA-350
Miller Pulstar 450
Gilliland CV 600 FI-PA

7. Wire feeders:

Airco AHF-NP
Airco System 1
M & K
Gilliland MTG2000

8. Welding gun (torches):

Airco/Binzel
Airco AH 35 C-2
M & K Cobramatic
Gilliland MTG-4001

Each of the pulse arc welding power sources, wire feeders, guns and accessories listed above were checked out during an equipment familiarization period. Scrap aluminum sheet and plate materials were used to make bead on plate type welds to establish basic welding machine settings for full penetration butt welds. As confidence levels increased, acceptable butt weld machine settings were established.

The welding test material flow diagram covering the range from "as procured" full. size sheet/plates to destructive testing is illustrated below:

- 1. Inspection and lay-out of cutting/shearing diagram for each full size 5000 series aluminum alloy sheet/plate.
- 2. Cutting/shearing full size sheet/plate into weld test piece parts approximately 8 inches x 12 inches for .063 inch, .100 inch, .125 inch,

- .250 inch and .500 inch thicknesses. Identify each piece part.
- 3 Machine square all 12 inch lengths preparatory for:
 - a) square butt joint (.063 inch .125 inch)
 - b) "J" groove joint (.250 inch .500 inch)
- 4. Clean all weld edges and joint areas by degreasing with approved solvent!
- 5. Mechanically clean by filing, scraping, milling or wire brushing with clean stainless steel rotary brush or hand brush all weld joint areas.
- 6. Manual GMAW tack weld each 8 inch x 12 inch aluminum alloy piece parts together with weld start/stop tabs to form a 16 inchx 12 inch weld test panel.
- 7. Manual pulse GMAW in vertical-up, horizontal or overhead welding position as required.
- 8. Non-destructive inspection of weld test panels: visual, penrtrant and radiographic. Reject or accept test panels. If rejected, cut out weld and recycle to step 3. If accepted, follow step 9.
- 9. Mill off weld surface and weld underbead from test panels.
- 10. Lay out and band saw test panels into rough oversize dimensions for transverse tensiles (2) and bend specimens (4). Steel stamp identification code.
- 11. Mill piece parts (rough dimensions) into final dimensions for transverse tensile (2), root bend (2), and face bend test specimens (2). (See section on Mechanical Properties in this report).
- 12. Conduct mechanical properties tests. Record data.
- 13. Evaluate, analyze and summarize weld test results as weld procedure specification qualification support data.

For clarity's sake, the reporting together with comments, results, and recommendations are covered with each specific test grouping. Each grouping includes the particular 5000 series aluminum alloy and temper, filler wire diameter and type, type of pulsed welding power source, type of wire feeder, gun and accessories utilized.

* * * * * * * *

5086 H-32 ALUMINUM ALLOY SHEET; .063 & .100 INCH THICKNESSES; AIRCO PA-3A/AHF-NP WIRE FEEDER/AH 35-C2 GUN; ER 5356 ALUMINUM ALLOY FILLER WIRE

As stated previously in the text, preliminary welding tests were initiated with use of the Airco PA-3A welding power source, AHF-NP wire feeder and AH 35-C2 manual GMAW gun. With the use of .035 inch diameter 5356 aluminum alloy filler wire it was not possible to get radiographically acceptable welds in the overhead welding position, i.e. Class 1 per NAVSHIPS 0900-003-9000, "Radiographic Standards for Production and Repair Welds."

On .10 inch thick 5086 H-32 aluminum alloy sheet using .035 inch diameter 5356 aluminum alloy filler material the vertical and horizontal specimens welded in the pulse spray mode using Airco PA-3A power supply, AHF-NP feeder and C-2 gun were not acceptable per radiographic testing. Using the PA-3A power supply in the pulse spray mode, it appears that overhead welding is difficult.

Acceptable Weld reinforcements on the second side was not achieved with use of the Airco PA-3A, 120 pulses per second, spray arc type transfer mode. The overhead weld reinforcement shape in .10 inch material thickness was not acceptable because of an incipient melting condition adjacent to the edges. This caused a discrepancy appearing similar to that of an undercut with the weld deposit being thinner than the base material thickness. Gravity appeared to disrupt the surface tension of the weld puddle causing the molten puddle to drop.

In the overhead position, meeting NAVSHIPS 0900-003-9000, Classl type procedure qualifications requirements for radiographic acceptance was difficult. However, there appears to be no problem meeting Class 3, production welding acceptance standards. Acceptable radiographic production quality level welds could be attained on a consistent and reliable basis.

* * * * * * * *

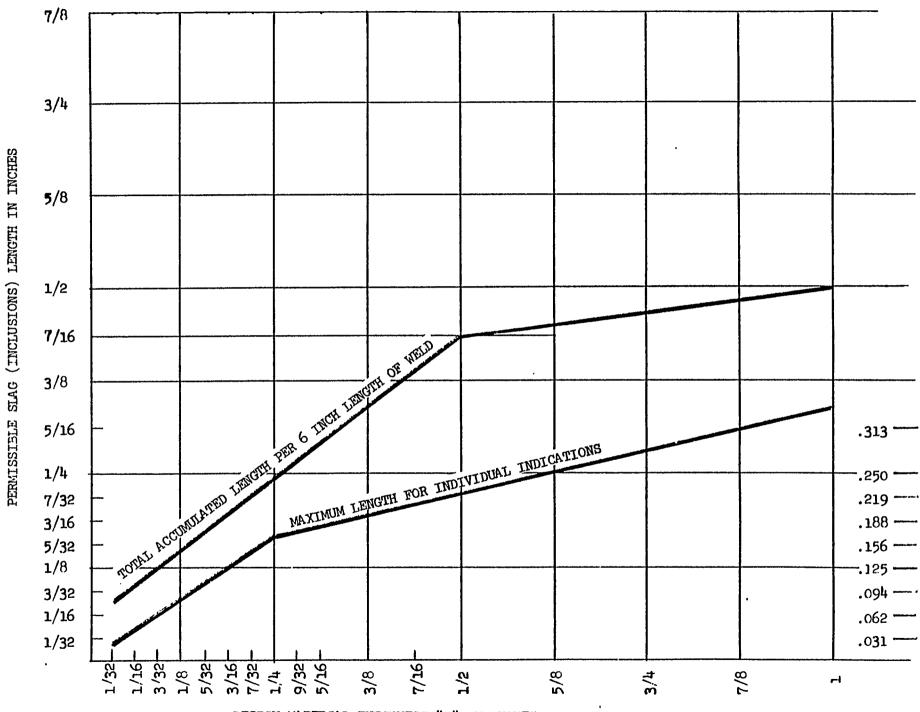
Because of the difficulty in meeting the radiographic requirements for Class 1, permissible length of slag (inclusions) in inches per the requirements of NAVSHIPS 0900-003-9000, a more realistic acceptance criteria for thinner sheet and plate in the 5000 series aluminum alloys appears necessary.

It was concluded that NAYSHIPS 0900-003-9000 is lacking in a clear acceptance definition for material thicknesses below 1/2 (one-half) inch for Class 1 and below 1/4 (one-fourth) inch thicknesses for Class 3, slag (inclusions) radiographic. The curves for both charts have been extrapolated to the left as accurately as feasible in an attempt to show better details in the areas for material thickness less than 1/2 inch for Class 1 and also 1/4 inch for Class 3. Figures 40 and 41 illustrate the curves extended to the left to cover acceptance limits for thinner materials.

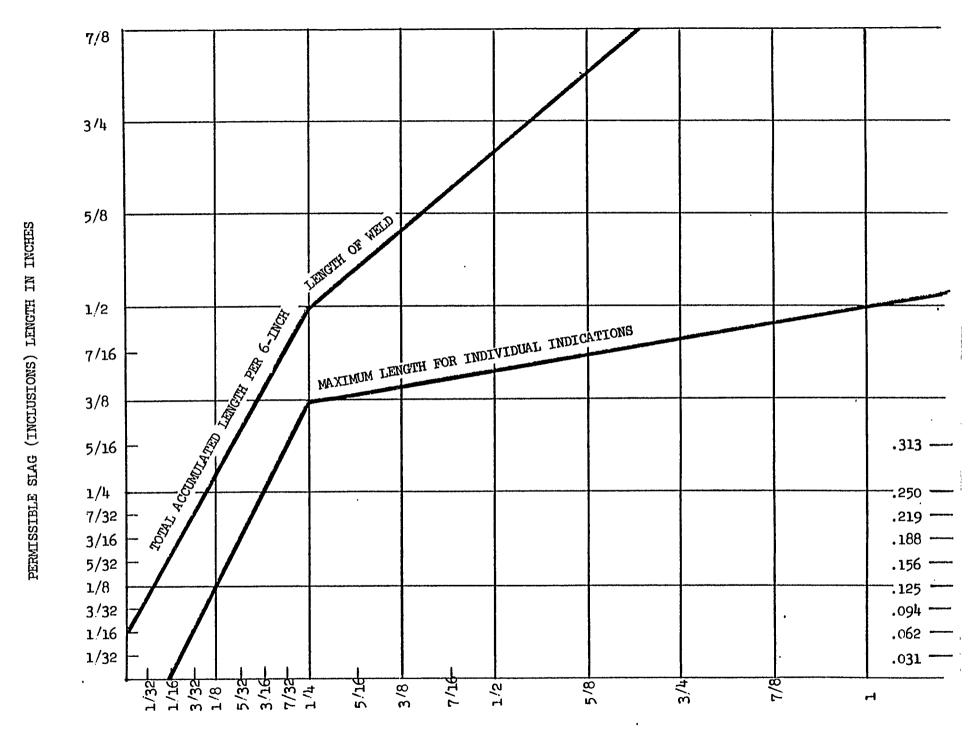
Further comparisons on acceptance standards for slag or inclusions of the American Bureau of Shipping (ABS) and NAVSHIPS 0900-003-9000 were drawn. The curves for the accumulated slag or inclusion appears identical for both. standards. However, the ABS curve for a single inclusion differs somewhat and appears more liberal above 3/4 inch thick plate. See Figure 42.

Considerable difference is illustrated in Figure 43 which compares the ultrasonic acceptance criteria for NAVSHIPS 0900-006-3010, Class 3 and ABS Class B. The maximum length of indications with signals exceeding The ARL (Amplitude Reject Level) is identical for both systems. The NAVSHIPS acceptance is more liberal above 1.75 inches for single indications and above 1.87 inches for accumulated indications.

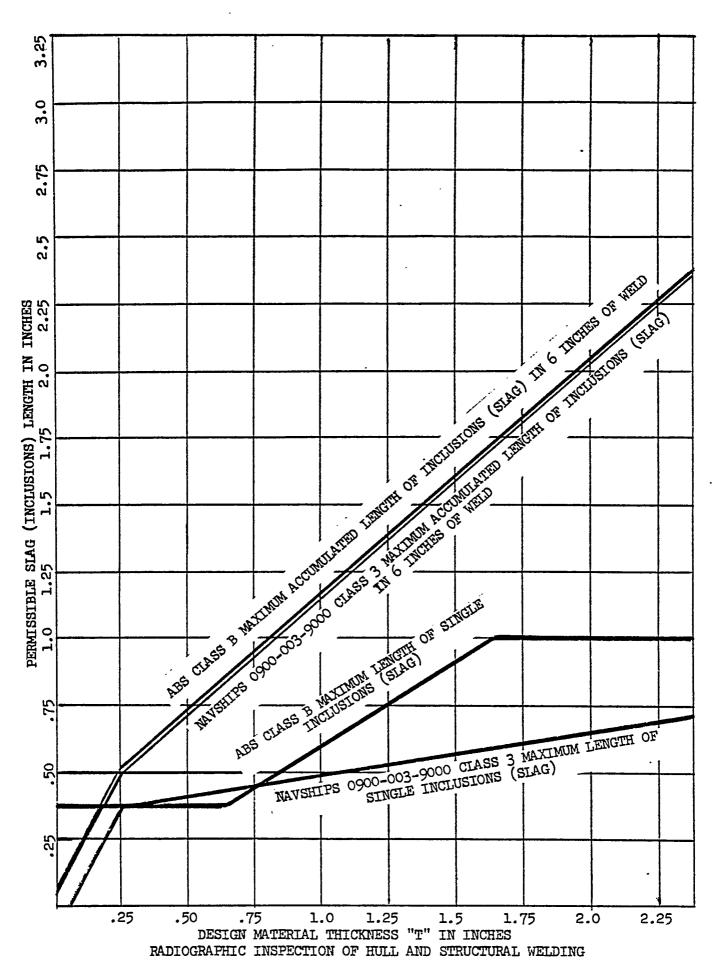
MIL-T-5021, "Tests; Aircraft and Missile Operators Qualification, "stipulates that for materials less than 3/16 inch thick, the maximum allowable defect size is 1/3 the material thickness or .060 inch whichever is less.

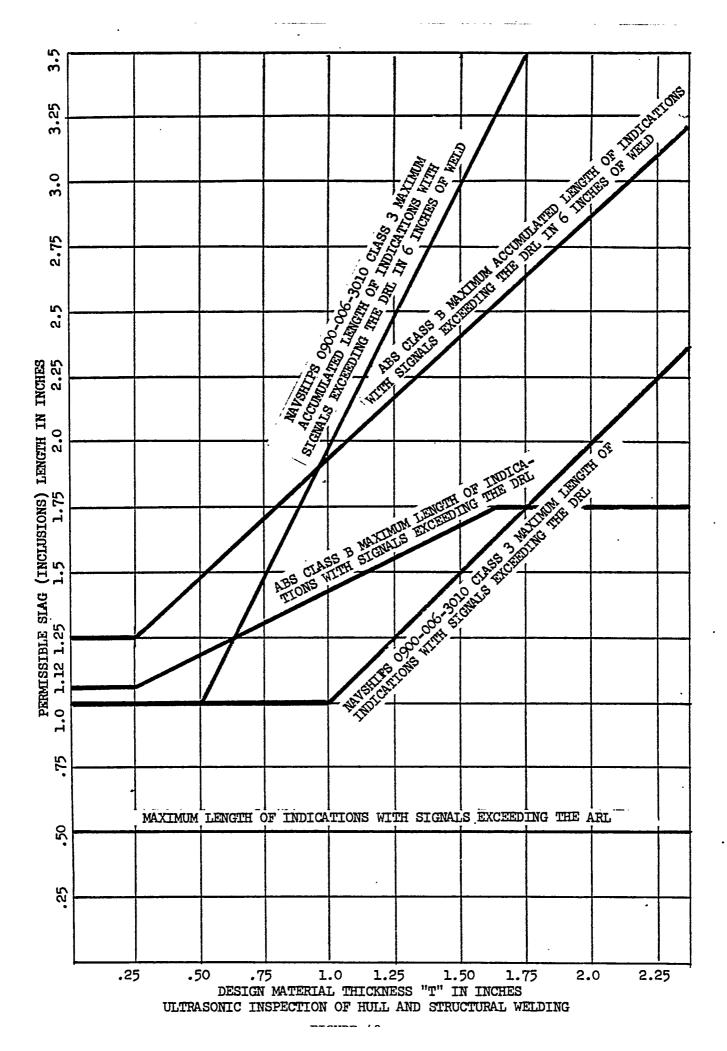


DESIGN MATERIAL THICKNESS "T" IN INCHES
NAVSHIPS 0900-003-9000 - CLASS I SLAG (INCLUSIONS)
FIGURE 40



DESIGN MATERIAL THICKNESS "T" IN INCHES
NAVSHIPS 0900-003-9000 - CLASS 3 SLAG (INCLUSIONS)
FIGURE 41





The Weld Ouality Requirements reads as follows:

- 4.4 Weld quality requirements.
 - 4.4.1 <u>Weld soundness.</u> Welds shall be free of cracks, incomplete fusion or penetration, overlap, undercut, surface voids and overlapping folds. Porosity shall not exceed the following limitations:
 - a. <u>Single porosity.</u> The maximum extent of single cavities shall not exceed 1/3 of the thickness of the thinner material ("t") of the joint or .060 inch, whichever is the lesser. Interconnected porosity shall be considered as a single cavity.
 - b. <u>Scattered porosity</u>. The sum of the areas in any plane of all the cavities contained in any one inch length of weld must not exceed 5 percent of an area in square inches equal to one times the thickness of the parent metal, or when unequal thicknesses are welded the thickness of the thinner material.
 - c. <u>Linear porosity.</u> The sum of the areas of the radiographic images, of three or more porosity cavities in alignment shall not exceed 2.5 percent of an area equal to one times the thickness of the thinner material welded. The maximum extent of linear porosity shall not exceed 1/3 the parent material thickness or .060 inch (whichever is less) and the width shall not exceed 10 percent of parent material thickness at any point.
 - 4.4.1.1 Inclusions, either tungsten or nonmetallic, shall be subject to the same dimensional limitations defined for scattered or linear porosity. Where both inclusions and porosity are present, the total of their combined lengths shall be within the limitations for porosity.

5086 H-32 ALUMINUM ALLOY SHEET: .100 INCH THICKNESS; ER 5356 ALUMINUM ALLOY FILLER; AIRCO PA-3A/PA-350

One complete set of .100 inch thick 5086 H-32, QQ-A-150/7, aluminum alloy sheet material was butt welded out-of-position with the use of full penetration one-side gas metal arc welding process. Two .100 inch thick 5086 H-32 aluminum alloy sheet material approximately 12 inches long x 8 inches wide were butt welded along the 12 inch length to make a weld test specimen panel of 12 inches wide x 16 inches long. Shielding gas used was 75% helium/25% argon. Flow rates were approximately 40 cu. ft. hr. These test panels were welded in the vertical-up, overhead and horizontal. welding positions. All test panels were radiographed and met requirements for Class 1 per NAVSHIPS 0900-003-9000 and MIL-STD-248C. The Airco PA-350 welding power source, System 1 wire feeder, and the Aircomatic (Binzel) 350 ampere air-cooled gas metal arc welding gun combination was utilized. Filler wire was .045 inch diameter 5356 aluminum alloy.

Typical weld machine settings for the various welding positions were as follows:

WELDING POWER SOURCE	WELDING POSITION	WIRE DIAMETER	AMPERES	VOLTAGE	INCHES PER MINUTE
AIRCO PA-3A PULSE MODE	VERTICAL-UP	.030"	45	19	15.6
AIRCO PA-3A PULSE MODE	HORIZONTAL	.035"	55	19	18
AIRCO PA-350 SHORT-ARC MODE	OVERHEAD	3/64"	70	16	17

It should be pointed out that in this set of test specimens, the vertical-up and also the horizontal welding positions were welded with .030 and .035 inch diameter filler wires respectively with the use of the Airco PA-3A welding power source, Airco AHF-NP wire feeder and AH35 C-2 pull gun. Porosity was a problem and therefore weld filler wire diameters were changed

to determine whether or not filler wire diameters might have been the cause. It appears that turning off the water in the water coolant system to the torch was the main resolution for the porosity problem when welding at low heat inputs. We decided to omit water recirculation in the water cooled torches for aluminum material thickness under .100 inch. At this point in the program, the Airco PA-3A power source malfunctioned and was sent back to the distributor for repairs and recalibration. All base line data and information was conducted with the use of the Airco 350 welding power source, System 1 wire feeder and the 350 ampere air cooled gun.

As illustrated in the above machine setting chart, the overhead panel was welded with the Airco 350 power source, System 1 wire feeder and 350 ampere Binzel (Aircomatic) air cooled GMAW torch.

Typical weld test set-up for vertical-up, overhead and horizontal positions are shown in Figures 44, 45, 46, and 47. Also, typical weld beads rejected either by visual or by radiography were sheared off approximately 1½ inches wide as illustrated in Figure 48.

* * * * * * *

Shortly after the decision to conduct our base line test development with the Airco PA-350/System 1 feeder/Binzel 2 position air cooled gun combination; at the 64th AWS Annual Convention held in Philadelphia during April 25-29, 1983; a paper entitled, "Study of Droplet Transfer in Pulsed GMAW Welding," was presented by S. Ueguri, K. Hara and H. Komura of Mitsubishi Electric Corporation, Japan. They claimed to have developed a pulsed GMA Welding machine in which the pulsed current is properly stabilized by feedback control of arc voltage. They further claimed that they had determined the required conditions for a proper current waveform by the pulse amplitude, the pulse duration and the pulse frequency, in which small droplet transfer from the wire to base material was attained with great consistency and reliability. And also that a stable arc and spatter free welding condition are achieved.

The key results of their study are quoted below:

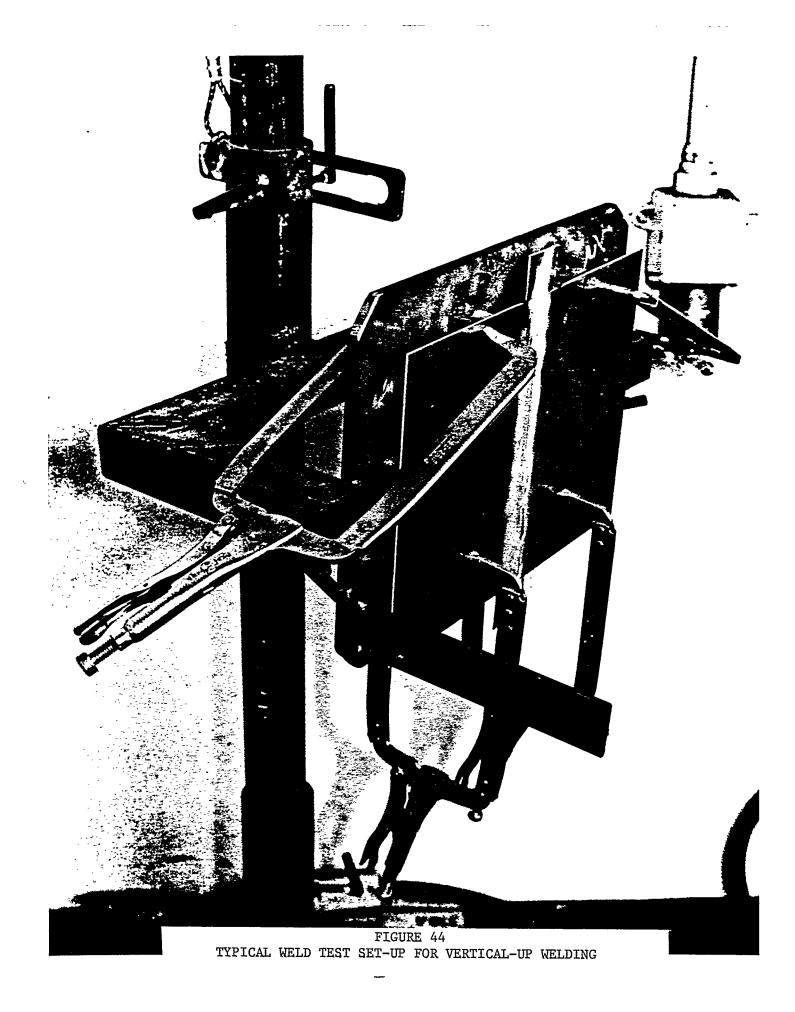
- "1. During the intitial part of the pulse duration including the base current period, the electrode tip is melted into the droplet. At the end of this part, the volume of pendant droplet at the tip is just so much that the gravity reinforced by the pinch effect overcomes the surface tension, and the droplet begins to move towards the base metal; then the temperature of droplet is at about its melting point, i.e. $(1535^{\circ}c)$."
- "2. The residual part of the pulse is necessary for the droplet to continue to move and detach finally from the electrode, Thus, the droplet is forced to be superheated up to about 2200°C."
- "3. The pulse duration must be just long enough so that the droplet may be heated, transferred and detached from the electrode. And under this condition, the pulse frequency has to be set enough that the electrode melting rate may be equal to the electrode feeding rate. When the duration is much smaller, the droplet fails to transfer to the base metal during one pulse and swells into a large globe which makes an arc unstable. When the duration is longer than necessary, the electrode tip is so much prolonged that the second or third droplet transfers from the wire during one pulse. In this case, the electrode tip is apt to touch the base metal causing much spatter."

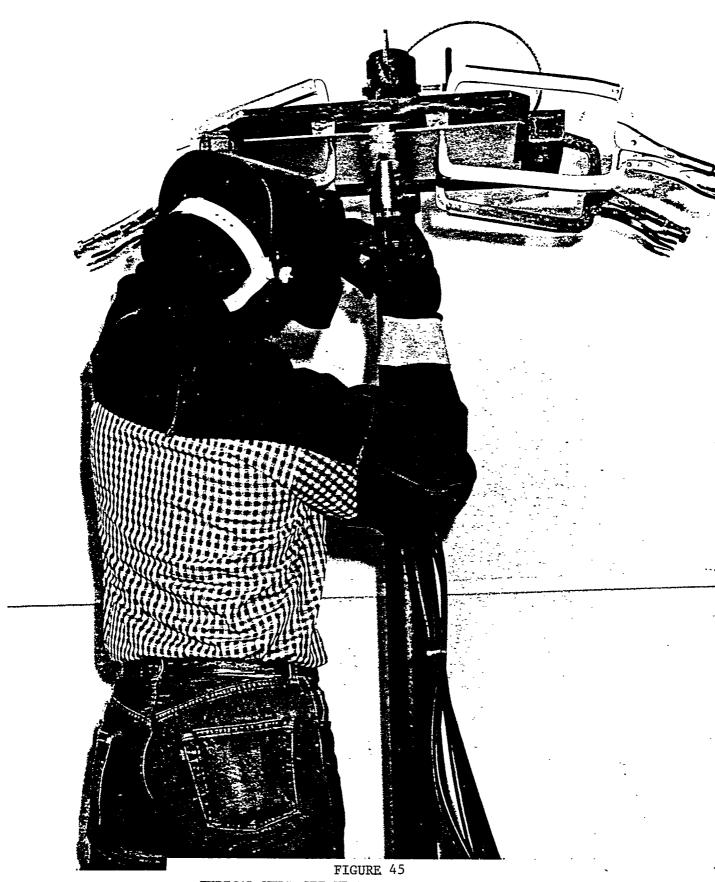
- "4. In the case of the spray transfer under the steady direct current, the arc heat is continuously put into the wire and the wire tip is prolonged inevitably. On the other hand, we can get a shorter and stabler arc by a proper pulsed current described above."
- "5. We calculated the profile of pendant droplet according to Greene's theory and found a good agreement between the calculated results and the experimental results observed with high-speed motion picture. Greene's theory has been developed for the steady direct current and not yet verified by any experiment. However, in the case of mild steel and stainless steel, we consider his theory is more suited for the pulsed current, since his assumption that the shape of pendant droplet is globular is more appropriately satisfied with batch input."

* * * * * * * *

Discussions previously with Mitsubishi Electric personnel at the AWS (American Welding Society) Welding Shows indicated that their pulse arc GMAW power surce was not recommended for welding aluminum or aluminum alloy materials.

The Airco PA-350 pulse arc welding power source does have capabilities to weld aluminum and aluminum alloys in addition to welding mild steel, stainless steel and other materials. The Airco PA-350 appears to conform very much to Messrs. S. Ueguri, et. al.'s description of a pulsed GMAW power source in which, "pulsed current is properly stabilized by feedback control of arc voltage."

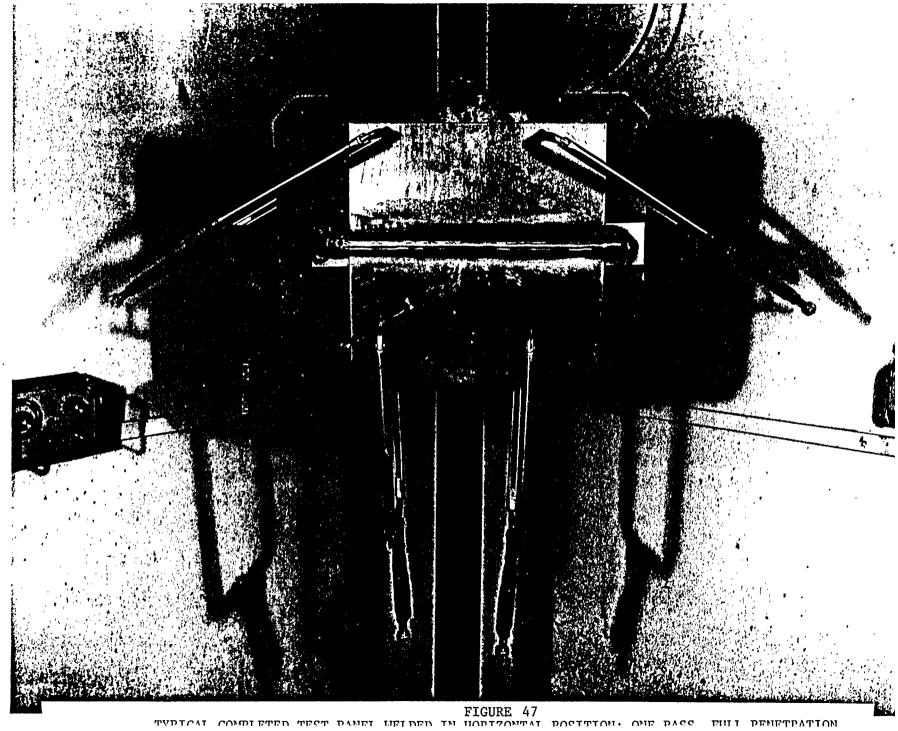




TYPICAL WELD SET-UP FOR OVERHEAD WELDING



TYPICAL WELD SETTING DEVELOPMENT APPROACH FOR HORIZONTAL WELD: FULL PENETRATION BUTT WELD





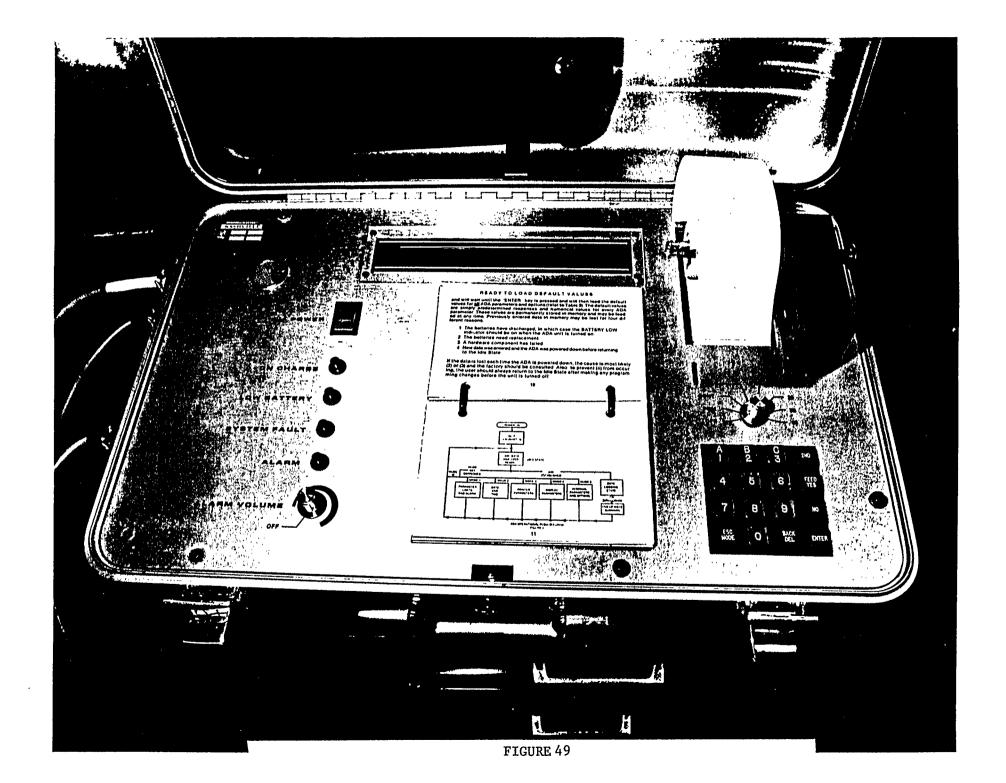
CRUTCHER RESOURCES CORPORATION (CRC) ARC DATA ANALYZER (ADA)

An arc data analyzer was procured from CRC Welding Systems; Houston, Texas to monitor and record our basic welding variables during the establishment of certified weld machine settings. See Figure 49.

The ADA thermal printout provides extensive welding information about each weld. Every log is prefaced with the date, time, welding station and the test number. The ADA prints the welding parameter values at a frequency selected by the user. In addition to printing the average values for arc voltage and current, the ADA computes and prints the standard deviation for these parameters. The standard deviation provides a statistical measure of the variation of voltage and current signals about their average values.

Upon completion of a weld, a printed summary showing total elapsed arc-on time, travel distance, length of filler wire used, total deposition and heat input is made available.

A typical thermal printout illustrating the data log is illustrated in Figure 50.



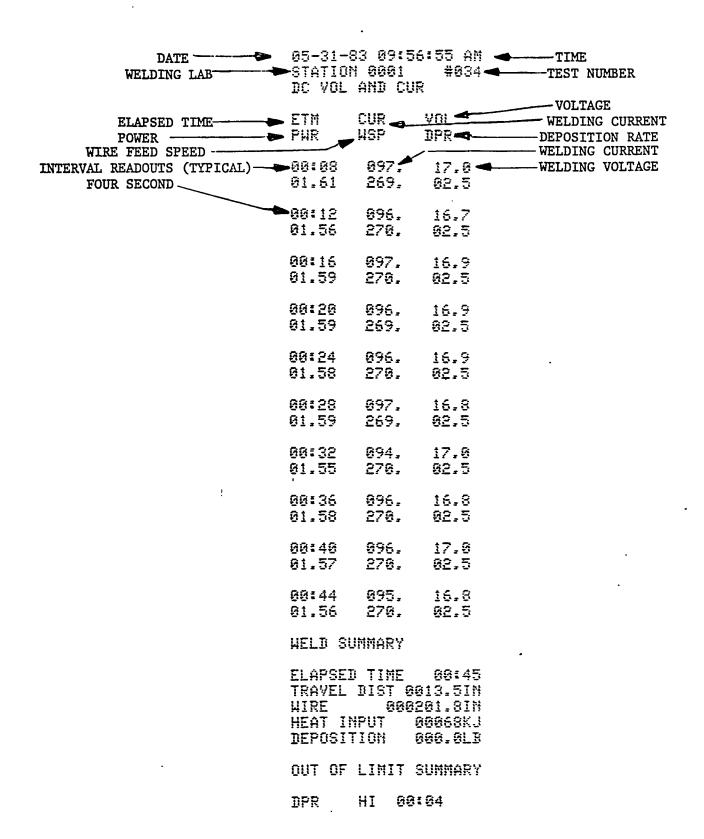


FIGURE 50

CRC ARC DATA ANALYZER DISPLAY OF WELDING VARIABLES

5086 H-32 ALUMINUM ALLOY SHEET: .063 INCH THICKNESS; ER 5556 ALUMINUM ALLOY FILLER WIRE; AIRCO PA-350

One set of .063 inch thick 5086 H-32, OO-A-150/7, aluminum alloy sheet material was butt welded out-of-position with the use of the full penetration one-side gas metal arc welding process. Two 1/16 inch thick x 8 inch wide x 12 inch long sheets were butt welded to make an approximately 12 inch x 16 inch test panel. See Figure 51, which shows the weld bead surface and underbead. These weld test panels were subsequently machined into mechanical properties specimens. i.e. Tensiles, root and face bend specimens. Start and stop tabs approximately 2 inches x 1 inch x .063 inch thickness of same aluminum alloy as the base materials were used so that maximum panel length could be used. Shielding gas used was 75% helium/25% argon. These test panels were welded in the vertical-up, overhead and horizontal welding positions. No flat (downhand) panels were welded because these are normally not required for welding procedure qualification. All test panels were radtographed and met Class 1 requirements per NAVSHIPS 0900-003-9000 and MIL-STD-248C. The Airco PA-350 welding power source, System 1 wire feeder and Aircomatic (Binzel) 350 ampere air-cooled gas metal arc qun was utilized. Filler wire was 3/64 inch diameter, 5556 aluminum alloy. Typical machine settings for the various welding positions are as follows:

WELDING	WIRE			TRAVEL SPEED	ALUMINUM ALLOY
POSITION	DIAMETER	AMPERE	VOLTAGE	INCHES PER MINUTE	FILLER WIRE
VERTICAL-UP	3/64 inch	50	15	18	ER 5556
OVERHEAD	3/64 inch	50	15.5	20	ER 5556
HORIZONTAL	3/64 inch	50	15	18	ER 5556

Specific pertinent machine settings that were used on test panels are covered later in the section covering weld machine settings.

Figures 52, 53, and 54 show the typical weld bead surfaces and also the penetration bead on the far side.

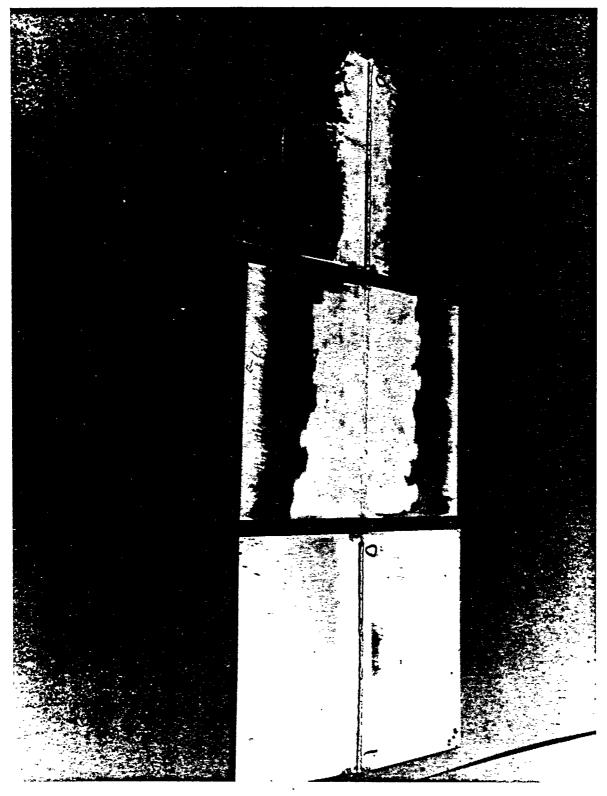
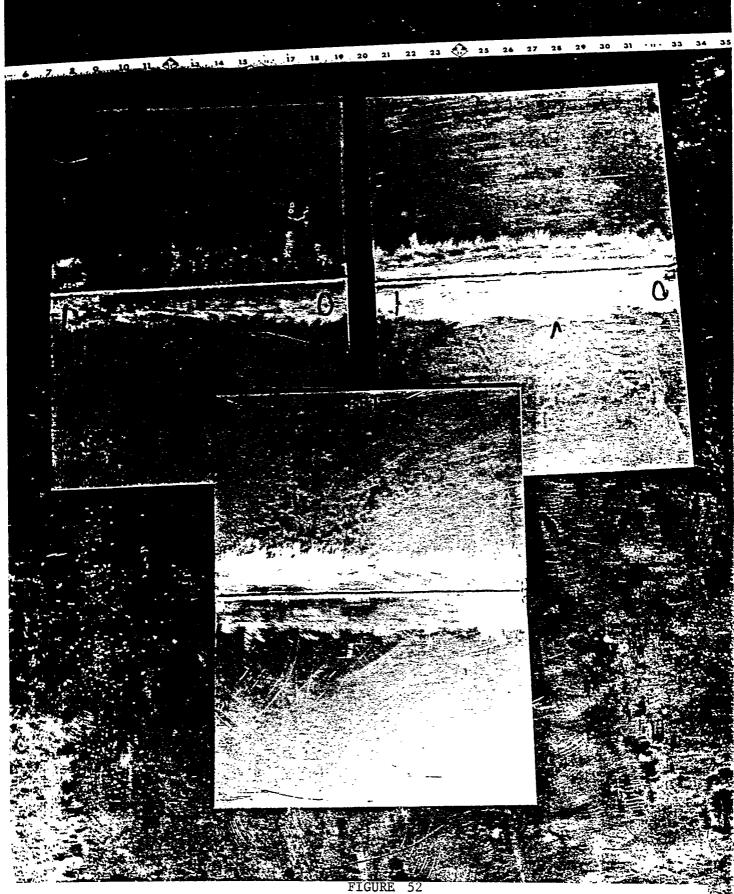
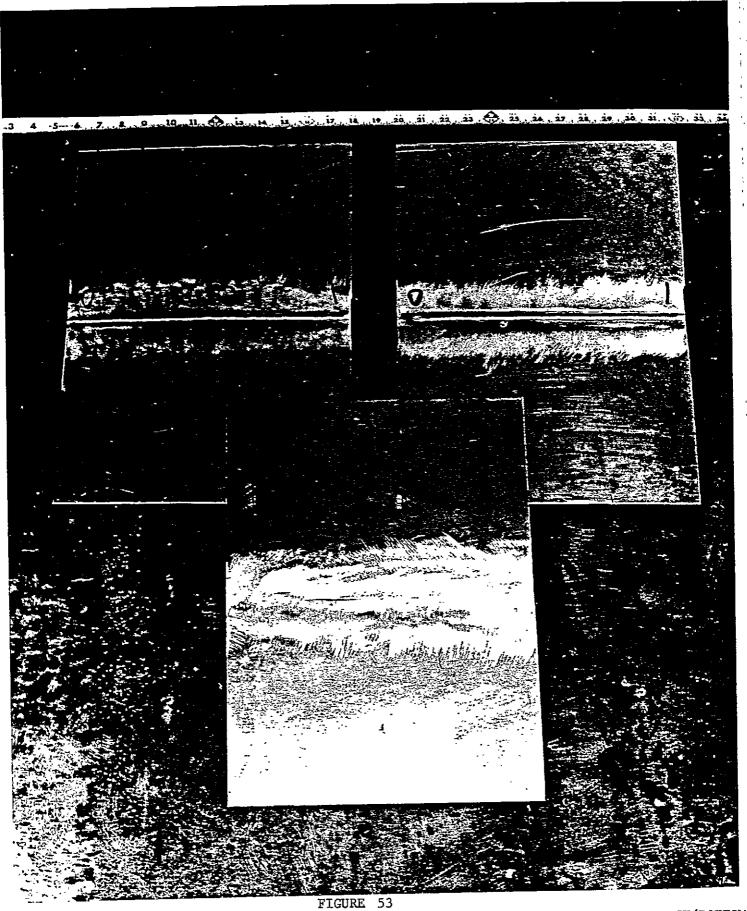


FIGURE 51

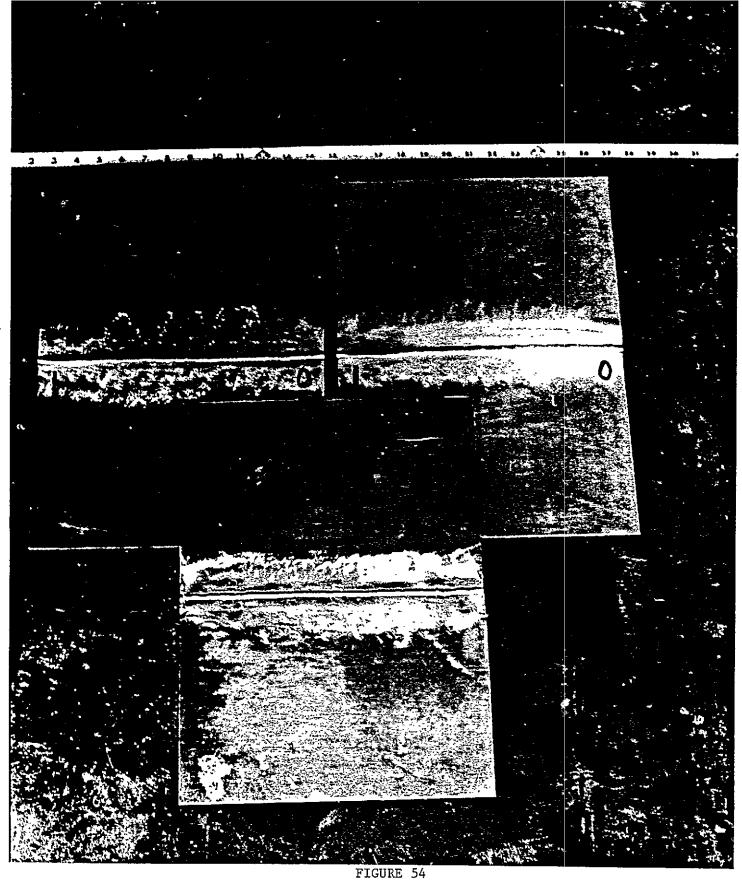
5086 H-32 ALUMINUM ALLOY SHEET 0.063 INCH THICK WELD TEST PANELS; WELD BEAD SURFACE (CENTER)/WELD BEAD UNDER BEAD (TOP/BOTTOM)



TYPICAL VERTICAL-UP WELD BEAD SURFACES (TOP LEFT & RIGHT) AND BACK WELD BEAD (BOTTOM)



TYPICAL QUERHEAD WELD BEAD SURFACES (TOP, LEFT & RIGHT) AND BACK BEAD MACHINED FLUSH(BOTTOM



TYPICAL HORIZONTAL WELD BEAD SURFACES (TOP, LEFT & RIGHT) AND BACK BEAD (BOTTOM)

5086 H-32 ALUMINIUM ALLOY SHEET: .063 INCH THICKNESS; ER 5356 ALUMINUM ALLOY FILLER WIRE; AIRCO PA-350

Two pieces of 7% inch wide x 12 inch long were butt welded with the gas metal arc welding process in the vertical-up position to make a 15 inch x 12 inch butt welded panel. Aluminum alloy filler wire used was 3/64 inch diameter 5356 aluminum alloy. The welding was accomplished in the short-arc mode on the Airco 350 power source, System 1 wire feeder and Aircomatic 350 ampere (Binzel) GMAW torch combination.

For some unknown reason it was not possible to attain Class 1 radiograph quality level butt welds in either the overhead or horizontal positions. Why it was feasible to weld in all positions with the use of 3/64 inch diameter 5556 aluminum alloy filler wire and not with the use of 5356 aluminum alloy wire was unknown at this point in time.

Typical machine settings for vertical-up welding were as follows:

WELDING	WIRE			TRAVEL SPEED
POSITION	DIAMETER	AMPERES	VOLTAGE	INCHES PER MINUTE
VERTICAL-UP	3/64 INCH	40	15.5	18.5

5083 H-323 ALUMINUM ALLOY SHEET: .125 INCH THICKNESS: ER 5356 ALUMINUM ALLOY FILLER WIRE; AIRCO PA-350

Out-of-position full penetration gas metal arc butt welding of .125 inch thick 5083 H-323, QQ-A-250/6, aluminum alloy sheet base material was completed. Two base metal plates each .125 inch thick x 8 inches wide x 12 inches. long were butt welded to make mechanical properties specimen test panels 12 inches x 16 inches. All test panels welded were radiographed to meet Class 1 requirements per NAVSHIPS 0900-003-9000 and MIL-STD-248C. The Airco PA-350 welding power source, System 1 wire feeder and Aircomatic (Binzel) 350 ampere air-cooled gas metal arc welding gun equipment combination was used. Typical short-arc welding machine settings for the various welding position and filler wire alloy and diameters are shown below:

FILLER WIRE	F	ΤT	JER	WIRE
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ALLOY & DIAMETER	WELDING POSITION'	AMPERES	VOLTAGE	TRAVEL SPEED INCHES PER MINUTE
ER 5356 3/64" dia.	VERTICAL-UP	70	17	14.1
ER 5556 3/64" dia.	VERTICAL-UP	70	17	12.8
ER 5556 3/64" dia.	HORIZONTAL	85	19.5	1.5
ER 5356 3/64" dia.	OVERHEAD	105	15	20

Out-of-position, one-side, full penetration manual pulsed GMAW butt welded test panels were etched in the weld cross sectional areas and visually inspected with 10X magnification. The etching reagent used for revealing the microstructure on the 5000 series aluminum test panels is listed below.

ETCHANT	FOR	ALUMIN	MUV	AND	ALUMINUM	ALLOYS
Hydrochl	oric	Acid	(Cc	one.)	15	ml.
Hydroflu	oric	Acid	(48	3왕)	10	ml.
Water					85	5 ml.

This solution was used at room temperature and applied on the prepared weld cross sectional area by swabbing.

The weld cross sectional surface areas were prepared by filing and sanding with metallographic paper. The etchant solution was swabbed on with cotton applicators until the desired contrast was attained. Upon etching, the test panel specimens were rinsed thoroughly and dried with warm air.

Typical etched weld cross sectional areas for .063 - .250 inch weld test panels are illustrated in Figure 55.



TYPICAL OUT-OF-POSITION, ONE-SIDE FULL PENETRATION MANUAL PULSED GMAW BUTT WELD CROSS SECTIONS (ETCHED)

5086 H-116 ALUMINUM ALLOY PLATE: .250 INCH THICKNESS; ER 5556 ALUMINUM-ALLOY FILLER WIRE; AIRCO PA-350

One set each of 1/4 inch thick, 5086 H-116, QQ-A-150/19, aluminum alloy plate materials were butt welded in the vertical-up and horizontal welding position. Two 1/4 inch thick x 8 inch wide x 12 inch long test piece parts were butt welded to make a 12 x 16 inch weld test panel. Both vertical-up and horizontal test panels were acceptable radiographically. However, acceptable overhead panels could not be attained per Class 1 requirements of NAVSHIPS 0900-003-9000. The Airco PA-350 welding power source, System 1 feeder, and the Binzel 350 ampere air-cooled torch setup was used. Filler wire was ER 5556 aluminum alloy in the 3/64 inch diameter size. Typical machine settings for the vertical-up and the horizontal positions are summarized below:

WELDING POSITION	WIRE DIAMETER	AMPERE	VO <u>LTAGE</u>	TRAVEL SPEED INCHES-PER-MINUTE.	ALUMINUM ALLOY FILLER WIRE
VERTICAL-UP	3/64"	150	16	11.5	ER 5556
HORIZONTAL	3/64"	149	14.5	8.4	ER 5556

For specific details, see following section on machine settings.

At a later date when developing radiographically acceptable weld machine settings, successful welds in the overhead position ora .250 inch. thick, 5086 H-116 aluminum alloy plates were attained with the use of 3/64 inch diameter 5356 aluminum alloy filler wire.

5456 H-116 ALUMINUM ALLOY PLATE: .250 INCH THICKNESS ER 5556 ALUMINUM ALLOY FILLER WIRE; AIRCO PA-350

One set each of 1/4 inch thick, 5456 H-116 aluminum alloy, QQ-A-150/20, plate materials were butt welded out-of-position in the vertical-up and horizontal positions. Two 1/4 inch thick x 8 inch wide x 12 inch long test piece parts were butt welded to make a 12 x 16 inch weld test panel. All test panels were acceptable when non-destructive tested, i.e. visual, penetrant, and radiographic. Full penetration, one-side welds in the overhead position could not be achieved. The Airco PA-350 welding power source, System 1 feeder and the Binzel 350 ampere air-cooled torch setup was utilized. Filler wire was 3/64 inch diameter, ER 5556 aluminum alloy. Typical machine settings for the vertical-up and horizontal positions are summarized below:

WELDING POSITION	WIRE DIAMETER	AMPERE	VOLTAGE	TRAVEL SPEED INCHES-PER-MINUTE	ALUMINUM ALLOY FILLER WIRE
VERTICAL-UP	3/64"	115	18	9.3	ER 5556
HORIZONTAL	3/64"	156	14.5	8.5	ER 5556

For specific pertinent details, see section on Machine Settings.

At a much later date when developing radiographically acceptable weld machine settings, successful welds in the overhead position on .250 inch thick, 5456 H-116 aluminum alloy plates were attained with the use of 3/64 inch diameter, 5356 aluminum alloy filler wires.

5083 H-321 ALUMINUM ALLOY PLATE: .250 INCH THICKNESS; ER 5556 ALUMINUM ALLOY FILLER WIRE; AIRCO PA-350

One set each of 1/4 inch thick, 5083 H-321 aluminum alloy, QQ-A-150/6, plate materials were butt welded in the vertical-up and horizontal positions. Two 1/4 inch thick x 8 inch wide x 12 inch long test piece parts were butt welded to make a 12 x 16 inch weld test panel. All test panels passed visual, penetrant and radiographic inspection requirements. Full penetration, one-side welds in the overhead position could not be attained. The Airco PA-350 welding power source, System 1 feeder and Binzel 350 ampere air-cooled torch welding set-up was utilized. Filler wire used was 3/64 inch diameter, ER 5556 aluminum alloy. The typical machine settings for the vertical-up and horizontal welding positions are summarized below:

WELDING	WIRE			TRAVEL	SPEED	ALUMINU	JM ALLOY
POSITION	DIAMETER	AMPER₩ O I	<u>rage I</u>	NCHES PE	ER MINUTE	FILL	ER WIRE
		_					
VERTICAL-UP	3/64"	130	15.7	12		ER 5	556
HORIZONTAL	3/64"	145	14.5	10.2	2	ER 5!	556

For more detailed information, see section on Machine Settings.

At a much later date when developing radiographically acceptable weld machine settings, successful welds in the overhead position on .250 inch thick, 5083 H-321 aluminum alloy plates were attained with the use of 3/64 inch diameter, 5356 aluminum alloy filler wires.

WELDING PROCEDURE SPECIFICATION QUALIFICATION DATA

Weld procedure qualification test summary pages covering the necessary welding parameters such as base material, filler wire type and diameters, shielding gas(es), pulse power source, torch, cup orifice, welding position, preheat, current characteristics, current range, voltage range, wire feed speeds, travel speed and non-destructive test results are shown in the following pages. Specific weld machine settings as well as mechanical properties data are covered under respective sections in this report.



SEATTLE DIVISION

WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	A1.3
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/92

DATE

WELDING PROCEDURE QUALIFICATION TEST SUBS	-RT DATE						
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	OPERATING PARAMETERS: WELDING POS. VERT-UP NO. PASSES 1 PREHEAT 60° MIN INTERPASS TEMP. CURRENT CHARAC. D.C. R.P. CURRENT RANGE 50						
QUALIFICATION JOINT	VOLTAGE RANGE 15						
MATERIALS: BASE SPEC. 00-A-150/7 5086 H-32	WIRE FEED IPM 125						
MATL. THICKNESS .063" FILLER SPEC. AWS A5.10-80 ER 5556	SHIELD FLOW 40 CFH TRAVEL SPEED 18 IPM						
FILLER DIA, 3/64" SHIELDING GAS 75%HE/25%AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PULSE ARC 350 TORCH OR HOLDER TYPE BINZEL	MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER						
CUP TYPE & SIZE 3/4" METALLIC ELECTRODE TYPE & SIZE NA							
NDT TESTS:							
DT TESTS: PLATE OR SPEC. SER. NO. X RST HRDNS CHARPY SIDE BEND X ROOT BEND X FACE BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	P.T. Acceptable - Report # 1609 attached R.T. Acceptable - Report # 7039 attached						
REMARKS:							
J.H. HITCH HILL 10879 WELD OPR. CLOCK NO.	J. JOHNSTON TEST BY QUAL. RANGE						
THIS CERTIFIES THAT THE DATA HEREIN IS COMPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE AND THAT TESTING AND EVALUATION WAS CONDUCTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED BELOW.							

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-10-83											
TODD ORDER NO. 4787 ITEM NO.	101.00 REPORT NO. 1609										
DYE PENETRA	NT NONDESTRUCTIVE TEST REPORT										
JOB DESCRIPTION											
MARAD PLATE GMAW SHORT ARC PROCESS											
FOR: TWPS No. A 1. 3	MATERIAL: Aluminum										
PENETRANT EQUIP. DUBL-CHEK; VISIBLE	RED PENETRANT TIME: 15-20 min.										
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.										
PER SPEC: MIL-STD-271 E NAVSH	TPS										

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

SHIPYARDS CORPORATION .

Seattle Divisient 1801 16th Avenue, S.W.

Seattle, Washington 98124 - 623-1635 (206)

REPORT NO. 7039

RADI	RADIOGRAPHIC INSPECTION REPORT-WELDMENTS												CONTRACT NO. NNS POM-70200-R HULL N/A				
108	OB NAME TWPS No. A 1 . 3 JOB N													OB NO. 478	37 .		ITEM NO. 101.00 PAGE 1 of 1
	DESCRIPTION MARAD PLATE GMAW SHORT ARC PROCESS MAT'L Aluminum .063 QUANTITY 1																
RSS	RSS NO. WQ-001-A QUALITY LEVEL: 2-27 ▼ 2-47% RT: 100% ▼ 50% □ 10% □ SPOT □																
PE(S)	IES)	SS (E 18		REP.	>	SKC	TION	ETE		_			DISPOS	ITION		MIL- STD-271-E 👿 NAVSHIPS 0900-003-9000,CLASS 1
FILM TYPE(S)	SFD(INCHES	(INCHESS	DUENC	VIEW	ORIG.or	POROSITY	CLUSI	INCOMPLETE PENETRATION	COMP	CRACK	UNDERCUT	SURFACE	OTHER	JOINT	ACCEPT	REJECT	ABS CLASS A CLASS BC
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106



SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	A1.23	
PROCEDURE NO.		
PROCESS	GMAW	
CONTRACT	MARAD SP-7	
DATE	12/1/83	

DATE

THE PART OF THE PA	
¥ 1 3	OPERATING PARAMETERS: WELDING POS. VERT-UP NO. PASSES 1 PREHEAT 60°MIN INTERPASS TEMP. CURRENT CHARAC. D.C. R.P. CURRENT RANGE 40
QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-150/7 5086 H32 MATL. THICKNESS .063" FILLER SPEC. AWS A5.10-80 ER 5356 FILLER DIA. 3/64" SHIELDING GAS 75%HE/25%AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PA 350 TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZE METALLIC 3/4" ELECTRODE TYPE & SIZE NA	VOLTAGE RANGE 15.5 WIRE FEED IPM 172 SHIELD FLOW 40 CFH TRAVEL SPEED 18.5 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER
NDT TESTS: X VIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-3 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-3 FILLET BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1611 attached R.T. Acceptable - Report # 7037 attached
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J. JOHNSTON TEST BY QUAL. RANGE
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 5-10-83										
TODD ORDER NO. 4787 ITEM NO.	101.00 REPORT NO. 1611									
DYE PENETRANT	NONDESTRUCTIVE TEST REPORT									
JOB DESCRIPTION										
MARAD PLATE	GMAW SHORT ARC PROCESS									
FOR: TWPS NO. A 1 . 23	MATERIAL: Aluminum									
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RE	D PENETRANT TIME: 15-20									
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.									
PER SPEC: MIL-STD-271 E , NAVSHIPS	S 0900-003-8000, CL <u>ASS I</u>									

CONTRACT NO. NNS FOM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR B. Dyer R. Bell

QA-PT.

SHIPYARDS CORPORATION .

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Weshington 98124 • 623-1635 (206)

REPORT NO. 7037

RADI	RADIOGRAPHIC INSPECTION REPORT-WELDMENTS											CONTRACT NO. NNS POM-70200-R HULL N/A					
													J	OB NO. 47	87.	=	ITEM NO.101.00 PAGE 1 of 1
			MA	RAD PLA	TE.			SHO							_		Aluminum .063 QUANTITY 1
RSS	RSS NO. WQ-001-A QUALITY LEVEL: 2-2T ☑ 2-4T □% RT: 100% ☑ 50% □ 10% □ SPOT □																
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FILM TYPE(S)	SFD(INCHES	ESS SJ	5		REP	=	喜	YET AT			5					T	NAVSHIPS 0900-003-9000,CLASS 1 ABS CLASS A CLASS B
<u></u>	EEC	E E	NEX.	AIEM	9	POROSITY	E			픙	UNDERCUT	3	8	JOINT	EPI	3	OTHER:
Ξ	SFD	(INCHESS)	SEQUENCE		ORIG.or	POH	38	INCOMPLETE PEKETRATION	黑色	CRACK	S	SURFACE	OTHER	A 1 . 23	ACCEPT	REJECT	REMARKS
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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	A1.14
PROCEDURE NO	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

DATE

WELDING PROCEDORE QUALIFICATION TEST SOMY	ART DATE
E S	OPERATING PARAMETERS: WELDING POS. HORIZONTAL NO. PASSES 1 PREHEAT 60 MIN INTERPASS TEMP. NA CURRENT CHARAC. DC RP CURRENT RANGE 50
QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-150/7 5086 H-32 MATL. THICKNESS .063" FILLER SPEC. AWS A5.10-80 ER 5556 FILLER DIA.3/64" SHIELDING GAS 75%HE/25%AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PA 350 TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZE METALLIC 3/4" ELECTRODE TYPE & SIZE NA	VOLTAGE RANGE 15 WIRE FEED IPM 168 SHIELD FLOW 40 CFH TRAVEL SPEED 18 TPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER
NDT TESTS: X YIS, X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-1 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-1 X FACE BEND Sat. Report # E28426-1 FILLET BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1610 attached R.T. Acceptable - Report # 7038 attached
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J. JOHNSTON TEST BY QUAL. RANGE
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE	5-10-83

TODD ORDER NO. 4787 . ITEM NO. 101.00 REPORT NO. 1610

DYE PENETRANT NONDESTRUCTIVE TEST REPORT

JOB DESCRIPTION

MARAD PLATE GMAW SHORT ARC PROCESS

FOR: TWPS NO. A 1 . 14

MATERIAL: Aluminum

PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED

PENETRANT TIME: 15-20 min.

REPORTS TO: Distribution

DEVELOPMENT TIME: 7-30 min.

PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-003-8000, CLASS I

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.





QA-RT-2

SHIPYARDS CORPORATION

REPORT NO. 7038 Seattle, Washington 98124 • 623-1635 (206) Saettle Divisient 1801 16th Avenue, S.W. DATE 5/9/83 CONTRACT NO.NNS POM-70200-R HULL N/A RADIOGRAPHIC INSPECTION REPORT-WELDMENTS-ofl IDB NO.4787 TWPS No. A 1 . 14 ITEM NO. 101.00 PAGE OB NAME DESCRIPTION GMAW .: SHORT ARC PROCESS MAT'L Aluminum .063 QUANTITY MARAD PLATE QUALITY LEVEL: 2-2T ☑ 2-4T □ --% RT: 100% ☑ 50% □ 10% □ SPOT □ RSS NO. WQ-001-A INCOMPLETE PENETRATION INCOMPLETE FUSION MIL- STD-271-E X FILM TYPE(S) DISPOSITION SFD(INCHES) THICKNESS (INCHES) HELUSIONS NAVSHIPS 0900-003-9000, CLASS ______ UNDERCUT POROSITY ABS CLASS A CLASS B ORIG.or REJECT CRACK OTHER: VIEW JOINT REMARKS A 1 a 14 1 1 .063 HORIZ Prior to removal of weld rein-0-1 0 forcement *Spatter CODE . ACCEPTABLE **RADIATION SOURCE:** . BORDERLINE PREPARED BY T. Moore X-RAY: KV _________ mA ______ 2 . EXCESSIVE IR-192: CURIES . APPROVED BY FILM SIZE AND QUANTITY SINGLE FILM X NO.DF VIEWS 41/4×17 41/2×10 MULTIFILM ACCEPTED BY BOTH RADIOGRAPHER(S) __T. Moore/C.Krofta

112



WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO. A2.5 PROCEDURE NO. **PROCESS GMAW** CONTRACT MARAD SP-7 DATE

DATE

METDING (MOCEDOINE GOVERN TOURISM (1201, 2013)	
£ 1 3	OPERATING PARAMETERS: WELDING POS. OVERHEAD NO. PASSES 1 PREHEAT 60 MIN INTERPASS TEMP. NA CURRENT CHARAC.D.C. R.P. CURRENT RANGE 50
QUALIFICATION JOINT	VOLTAGE RANGE 15.5
MATERIALS:	"
BASE SPEC. QQ-A-150/7	WIRE FEED IPM 155
5086 H-32 ATL. THICKNESS .063"	SHIELD FLOW 40 CFH
ILLER SPEC. AWS A5.10 - 80	TRAVEL SPEED20 IPM
ER 5556	
TILLER DIA. 3/64"	MAX. HEAT INPUT J/IN_NA
SHIELDING GAS 75%HE/25%AR FLUX AND SIZE NA	HEAT TREAT NA
EQUIPMENT:	
POWER SUPPLY AIRCO PA 350	
TORCH OR HOLDER TYPE BINZEL	OTHER
CUP TYPE & SIZE METALLIC 3/4"	
ELECTRODE TYPE & SIZE NA	
IDT TECTC:	RESULTS:
NDT TESTS:	Visual - No visible defects
X VIS, X PT UT X RT MT	
	P.T. Acceptable - Report # 1612 attached
OT TESTS: PLATE OR SPEC. SER. NO.	D. M. Assessable Percent # 70/0 estrabed
X RST Sat. Report # E28426-4	R.T. Acceptable - Report # 7040 attached
HRDNS	
CHARPY	
X ROOT BEND Sat, Report # E28426-4	
X FACE BEND Sat. Report # E28426-4	
FILLET BEND	
FILLET BREAK TRANS.SHEAR	
LONG SHEAR	
EXPL.BULGE	
OTHER	
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TWADICO.	
REMARKS:	
11111	
J.H. HITCH 10879	J. JOHNSTON
WELD OPR. / CLOCK NO.	TEST BY QUAL. RANGE
AND THAT TESTING AND EVALUATION WAS CONDU	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED
BELOW.	·
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TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-10-83								
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1612							
DYE PENETRANT NONDE:	STRUCTIVE TEST REPORT							
JOB DESCRIPTION								
MARAD PLATE GMAW	SHORT ARC PROCESS							
FOR: TWPS No. A 2.5	MATERIAL: Aluminum							
PENERANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.							
REPORTS TO: Distribution	DEVELOPMENT TIME : 7-30 min.							
PER SPEC: MIL-STD-271_E_, NAVSHIPS 0900)-003-8000, CL <u>ASS I</u>							

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR R. Bell

QA-PT-

SHIPYARDS CORPORATION

-	_				-
Seetti	a Divisiom	1801	16th Avenue,	5.W.	5

leartile, Washington 96124 + 623-1635 (206)

REPORT NO. 7040

ADIOGRAPHIC INSPECTION REPORT-WELDMENTS									NTS				CONTRACT NO. NNS POM-70200-R HULL N/A				
)B	IB NAME TWPS No. A 2.5											J	OB NO. 4787			ITEM NO. 101.00 PAGE 1 of1	
				RAD PLA		GN		SHOP					S		h	AAT'I	Aluminum .063 QUANTITY 1
<u>SS</u>	NO.	W2-0	01-	-A		Ql	<u>JALI</u>	TY LI	VEL:	2-	2T [X :	2-4	「□% RT	: 101	0% 🛭] 50%□ 10%□ SPOT□.
E(S)	ESJ	S	2		REP.		¥5	NO.	313					DISPOS	ITION	į	MIL- STD-271-E 💢 NAVSHIPS 0900-003-9000,CLASS 🗓
FILM TYPE(S)	SFD(INCHES	THICKNESS (INCHES)	UENCE	VIEW	ORIG.or R	POROSITY	LUSIO	INCOMPLETE PENETRATION	ON NOIS	×	ERCU	SURFACE	E	JOINT	ACCEPT	REJECT	ABS CLASS A CLASS B CTHER:
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AC BC	CODE ACCEPTABLE BORDERLINE EXCESSIVE RADIATION SOURCE: X-RAY: KV MA _ 2 PREPARED BY Moore IR-192: CURIESN/A APPROVED BY																
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TEST SERIES NO	B1.18	
PROCEDURE NO.		
PROCESS	GMAW	_
CONTRACT	MARAD SP-7	
DATE	12/1/83	_

MEEDING PROCEDURE GOVERN TON 1001 1031 3033	
QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-150-7	OPERATING PARAMETERS: WELDING POS. VERTICAL_IIPNO. PASSES I PREHEAT 60°MIN INTERPASS TEMP. NA CURRENT CHARAC. D.C. R.P. CURRENT RANGE 45 AMP. VOLTAGE RANGE 19 VOLTS WIRE FEED IPM 300 T.P.M. SHIELD FLOW 40 CFH TRAVEL SPEED 15.6 I.P.M. MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER
NDT TESTS: X VIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-5 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-5 X FACE BEND Sat. Report # E28426-5 FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1613 attached R.T. Acceptable - Report # 7041 attached
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J. JOHNSTON TEST BY QUAL. RANGE
THIS CERTIFIES THAT THE DATA HEREIN IS CONDUCTION THAT TESTING AND EVALUATION WAS CONDUCTED.	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED WELDING ENGINEER DATE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE	5-10-83	<u>-</u>							
TODD ORD	ER NO. <u>4787</u> .	ITEM No	101.00	REPORT N	1613				
	DY	E PENETRANT	NONDESTRUCTIVE	TEST REPORT					
	JOB DESCRIPTION								
		MARAD PLATE	E GMAW SHORT ARC	PROCESS					
FOR: TWP	S No. B 1 . 18		MATERIAL	: Aluminum					
PENETRAN	T EQUIP. DUBL-CH	ek; visible Re	ED PENETRAN'	T TIME: 15-20 min					
REPORTS	TO: Distribution		DEVELOPME	NT TIME : 7-30 m	in.				
PER SPEC	: MI L-STD-27 <u>1 E</u>	, NAVSHIPS	0900-003-8000,	CLASS <u>I</u>					

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR R. Bell ...

OA-PT-

SHIPYARDS CORPORATION .

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 - 623-1635 (206)

REPORT NO. 7041

RADIOGRAPHIC INSPECTION REPORT-WELDMENTS													_	CON	TRAI	CT N	10. N	DATE 5/9/83 NS POM-70200-R HULL N/A	
_	NAM						.]						J	OB	NO.				ITEM NO. 101.00 PAGE 1 of 1
	DESCRIPTION MARAD PLATE GMAW SHORT ARC PR																		
RSS NO. WQ-001-A QUALITY LEVEL: 2-27 \(\text{Z} \) 2-47 \(\text{L%} \) RT: 100% \(\text{Z} \) 50% \(\text{L} \) 10% \(\text{S} \) SPOT \(\text{L} \)																			
	<u></u>		2		نه		5	-3E						Ī	DIS	POS	ITION	l	MIL- STD-271-E X NAVSHIPS 0900-003-9000,CLASS 1
YPE	HE	ESS SJ	2		REP	1	3	PLET ZATI			5	ييا		۲					ABS CLASS A CLASS B
FILM TYPE(S)	SFD(INCHES	THICKNESS (INCHES)	SEQUENCE	VIEW	ORIG.or	POROSITY	INCLUSIONS	INCOMPLETE PENETRATION		CRACK	UNDERCUT	SURFACE	OTHER		JOIN	T	ACCEPT	REJECT	OTHER:
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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	B.50
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-150/7 5086 H-32 MATL. THICKNESS .100 FILLER SPEC. AWS A5.10-80 ER 5356 FILLER DIA035" SHIELDING GAS 75%HE/25%AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PA 3A TORCH OR HOLDER TYPE AH 35 C-2 CUP TYPE & SIZE METALLIC 3/4" ELECTRODE TYPE & SIZE NA NDT TESTS: X VIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-6 HRDNS CHARPY SIDE BEND X ROOT BEND X ROOT BEND Sat. Report # E28426-6 FILLET BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	OPERATING PARAMETERS: WELDING POS. HORIZONTAL NO. PASSES 1 PREHEAT 60°MIN INTERPASS TEMP. NA CURRENT CHARAC. D.C. R.P. CURRENT RANGE 55 VOLTAGE RANGE 19 WIRE FEED IPM 260 SHIELD FLOW 40 CFH TRAVEL SPEED 18 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1607 attached R.T. Acceptable - Report # 7050 attached
REMARKS:	
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J.JOHNSTON TEST BY QUAL. RANGE
AND THAT TESTING AND EVALUATION WAS CONDUCTED BELOW.	APLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED
	01. 21101

WELDING ENGINEER

TODD SHIPYARDS CORPORATION SEATTLE DIVISION OUALITY ASSURANCE DEPARTMENT

QUALITY	ASSURANCE	DEPARTMENT

TODD	ORDER	NO.	4787	ITEM NO.	101.00	REPORT NO.	1607	

DYE PENETRANT NONDESTRUCTIVE TEST REPORT

JOB DESCRIPTION

MARD PLATE GMAW SHORT ARC PROCESS

FOR: TWPS No. B . 50	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20min.
REPORTS TO: Distribution	DEVELOPMENT TIME : 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900	-003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

5-10-83

DATE___

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR R. Bell

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7050

ADIOGRAPHIC INSPECTION REPORT-WELDMENTS												CONTRACT NO. NNS POM 70200-R HULL N/A					
												<u> </u>	OB NO. 478			ITEM NO. 101.00 PAGE 1 of 1	
		TION		ARAD PLA			MAN	SHO	RT A	RC	PRO	CE		OD 110.		ATT	Aluminum .100 QUANTITY 1
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<u>s</u>	-		2											DISPOS	===		MIL· STD·271·E 🔯 NAVSHIPS 0900-003-9000,CLASS 1
IPE	黑	SS	3	1		 =	置		<u>-</u>		5	 	<u> </u>		<u> </u>	I	NAVSHIPS 0900-003-9000, CLASS
<u>-</u>	SFD(INCHES	E E	SEQUENCE	VIEW	ORIG. or REP.	POROSITY	S	FIE		Š	E C	豆	3	TNIOL	E	5	ABS CLASS A CLASS B CTHER:
FILM TYPE(S)	SFD	THICKNESS (INCHES)			8	2	2	INCOMPLETE PENETRATION		CRA	暑	SURFACE	OTHER	B • 50	ACCEPT	REJECT	REMARKS
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AC BO EX	CODE ACCEPTABLE BORDERLINE EXCESSIVE RADIATION SOURCE: X-RAY: KV 70 MA 2 PREPARED BY T. Moore EXCESSIVE R-192: CURIES N/A											T. Moore					
SINGLE FILM \(\text{NO.0F} \) FILM SIZE AND QUANTI VIEWS \(\frac{4\pi_{\text{NO.10}}}{4\pi_{\text{NO.10}}} \) BOTH \(\text{1} \) 2								(D)	DUAI	TIT	Y	APPROVED BY ACCEPTED BY					
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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	B.74
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

	OPERATING PARAMETERS:
\ 	WELDING POS. OVERHEAD NO. PASSES 1 PREHEAT 60 MIN INTERPASS TEMP. NA
1/	PREHEAT 60 MIN INTERPASS TEMP. NA
£ 1	CURRENT CHARAC. D.C. R.P.
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	CURRENT RANGE 70
QUALIFICATION JOINT	VOLTAGE RANGE 16
MATERIALS:	"
BASE SPEC. QQ-A-150/7	WIRE FEED IPM 205
5086 H-32	
MATL. THICKNESS ,100"	SHIELD FLOW 40 CFH
FILLER SPEC. AWS A5.10-80	TRAVEL SPEED 17 IPM
ER 5356	
FILLER DIA. 3/64"	MAX. HEAT INPUT J/IN NA
SHIELDING GAS 75%HE/25%AR	HEAT TREAT NA
FLUX AND SIZE NA	
EQUIPMENT:	
POWER SUPPLY AIRCO PA 350	
TORCH OR HOLDER TYPE BINZEL	OTHER
CUP TYPE & SIZE METALLIC 3/4"	
ELECTRODE TYPE & SIZE NA	
LLLC HODE HE & SIZE HA	
NDT TESTS:	RESULTS:
	Viaual - No visible defects
X VIS. PT X UT X RT MT	
	P.T. Acceptable - Report # 1614 attached
DT TESTS: PLATE OR SPEC. SER. NO.	
X RST Sat. Report # E28426-7	R.T. Acceptable - Report # 7043 attached
HRDNS	
CHARPY	
SIDE BEND	
X ROOT BEND Sat. Report # E28426-7	
x FACE BEND Sat. Report # E28426-7	
FILLET BEND	
FILLET BREAK	
TRANS. SHEAR	
LONG SHEAR	
EXPL.BULGE	
OTHER	
	11
REMARKS:	•
17/2/4/ /	
J.H. HITCH HAVE 10879	J.JOHNSTON
WELD OPR. CLOCK NO.	TEST BY QUAL. RANGE
THIS CERTIFIES THAT THE DATA MEDETAL TO COL	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE
AND THAT TESTING AND EVALUATION MAS CONDU	CTED IN ACCORDANCE WITH THE REQUIREMENTS : TOTAL
BEI UM ITALI TESTING WIND ENWENNITON MAS CONDU	CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED
BELOW.	
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	James Compation
	WELDING ENGINEER DATE

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DATE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 5	-10-83									
TODD ORDER	NO. 4787 . ITEM NO. 101.0) REP	ORT NO.	1614						
,	DYE PENETRANT NONDE	STRUCTIVE TEST REPORT								
JOB DESCRIPTION MARAD PLATE GMAW SHORT ARC PROCESS										
FOR: TWPS	No. B . 74	MATERIAL: ,Aluminum								
PENETRANT	EQUIP. DUBL-CHIIK; VISIBLE RED	PENETRANT TIME: 15-2	0 min							
REPORTS TO): Distribution	DEVELOPMENT TIME: 7	-30 min.							
DED CDEC.	MII CUD 271 E MANCHIDO 000	0 002 0000 CTAGG T								

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

SHIPYARDS CORPORATION

Seettle Division: 1801 16th Avenue, S.W.

Seattle, Weshington 98124 • 623-1635 (206)

REPORT NO. 7043

IADIOGRAPHIC INSPECTION REPORT-WELDMENTS												CONTRACT NO. NNS POM-70200-R HULL N/A					
													OB NO. 47		0. <u>N</u>	ITEM NO. 101.00 PAGE 1 of 1	
							W S	SHOR	r AR	C P	ROC	ESS		00 AU. 4/		AT'I	Aluminum .100 QUANTITY 1
	ESCRIPTION MARAD PLATE GMAW SHORT ARC PROCESS MAT'L Aluminum .100 QUANTITY 1 ISS NO. WQ-001-A QUALITY LEVEL: 2-27 2 2-47% RT: 100% 3 50% 10% SPOT																
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	ES	ss —	H	ļ	문	_	S		ETE		<u>_</u>		•	DISTUS	11106	<u>'</u>	MIL- STD-271-E X NAVSHIPS 0900-003-9000, CLASS 1
I	皇	FES	33	VIEW	5	S	2	32		×	200	SE SE	~	10.11	Ы	13	ABS CLASS A CLASS B COTHER:
FILM TYPE(S)	SFD(INCHES	THICKNESS (INCHES)	3	VIEW	ORIG. or REP	POROSITY	INCLUSIONS	INCOMPLETE PENETRATION		CRACK	UNDERCUT	SURFACE	OTHER	JOINT	ACCEPT	REJECT	
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	RADIOGRAPHER(S) T. Moore																
QA	QA-RT-2																



SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO. C.60

PROCEDURE NO. PROCESS GMAW

CONTRACT MARAD SP-7

DATE 12/1/83

1000 1100 1100 0110 Qui 110 110 110 110 110 110 110 110 110 11	
11	<u>OPERATING PARAMETERS:</u>
/ 	WELDING POS VERTICAL-UP NO. PASSES 1 PREHEAT 60 MIN INTERPASS TEMP. NA
× 11	PREHEAT 60 MIN INTERPASS TEMP. NA
8 3	CURRENT CHARAC. D.C. R.P.
	CURRENT RANGE 70
QUALIFICATION JOINT	VOLTAGE RANGE 17
MATERIALS:	
BASE SPEC. QQ-A-250/6	WIRE FEED IPM 225
5083 Н323	
MATL. THICKNESS .125"	SHIELD FLOW 40 CFH
FILLER SPEC. AWS A5.10-80	TRAVEL SPEED 12.8 IPM
ER 5556	
FILLER DIA. 3/64"	MAX. HEAT INPUT J/IN NA
SHIELDING GAS 75%HE/25%AR	HEAT TREAT NA
FLUX AND SIZE NA	TEAT TREAT
EQUIPMENT:	
POWER SUPPLY AIRCO PA 350	OTHER
TORCH OR HOLDER TYPE BINZEL	OTTER
CUP TYPE & SIZE METALLIC 3/4"	
ELECTRODE TYPE & SIZE NA	
NDT TESTS:	RESULTS:
	Visual - No visible defects
X YIS, X PT UT X RT MT	
	P.T. Acceptable - Report # 1617 attached
DT TESTS: PLATE OR SPEC. SER. NO.	100000000000000000000000000000000000000
	R.T. Acceptable - Report # 7045 attached
X RST Sat. Report # E28426-10	Rest. Receptable Report # 7043 decached
HRDNS	
CHARPY	
SIDE BEND	
X ROOT BEND Sat. Report # E28426-10	
X FACE BEND Sat. Report # E28426-10	
FILLET BEND	
FILLET BREAK	
TRANS. SHEAR	-
LONG SHEAR	
EXPL.BULGE	
OTHER	
	11
REMARKS:	
J.H. HITCH 10879	J. JOHNSTON
WELD OPR. / CLOCK NO.	TEST BY QUAL. RANGE
T/20 0FFFFFFF T/2 T/2 D/24 / TD/27/ T/2 00	NATIONAL AND ADDRESS TO THE PROPERTY OF THE PR
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE .
	ICTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED
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	WELDING ENGINEER DATE
	THE UNITED THE PROPERTY OF THE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-10-83										
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1617									
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT									
JOB DESCRIPTION										
MARAD PLATE GMAW SHORT ARC PROCESS										
FOR: TWPS No. C . 60	MATERIAL: Aluminum									
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED PENETRANT TIME: 15-20 min.										
REPORTS TO: Distribution	DEVELOPMENT TIME : 7-30 min.									
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-003-8000, CLASS I										

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR R. Bell

QA-PT.



SHIPYARDS CORPORATION

Seattle Divisient 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7045

																	NS POM 70200-R HULL N/A
IADIOGRAPHIC INSPECTION REPORT-WELDMENTS														CONTRA	CT N	10. <u>N</u>	NS POM 70200-R HULL N/A
OB	NAM	E 1	WP	S No.	C.	60								OB NO. 47	87.		ITEM NO. 101.00 PAGE 1 of 1
				RAD PLA				GM	AW S	HOF	T I	ARC	PR	OCESS	, k	AT'I	Aluminum .125 QUANTITY 1
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πA	RADIOGRAPHER(S) T. Moore																
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SEATTLE DIVISION

TEST SERIES NO	C.63
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

DATE

METDING EXOCEDORE GOALIFICATION (EST SOMM)	IRT DATE
QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/6	OPERATING PARAMETERS: WELDING POSVERTICAL-UP NO. PASSES1 PREHEAT60 MIN
ELECTRODE THE & SIZE NA	
NDT TESTS: X yrs. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-11 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-11 X FACE BEND Sat. Report # E28426-11 FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1618 attached R.T. Acceptable - Report # 7044 attached
REMARKS:	·
J.H. HITCH H 10879	J.JOHNSTON
WELD OPR. CLOCK NO.	TEST BY QUAL. RANGE
	APLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION . SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 5-10-83	
TODD ORDER NO. 4787 . ITEM NO. 101	.00 REPORT NO <u>. 1618</u>
DYE PENETRANT NON	DESTRUCTIVE TEST REPORT
JOB	DESCRIPTION
MARAD PLATE GMA	AW SHORT ARC PROCESS
FOR: TWPS No. C . 63	MATERIAL: Alminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E . NAVSHIPS 09	900-003-8000. CLASS I

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

SHIPYARDS CORPORATION

Neshington 98124 • 623-1635 (206)

REPORT NO. 7044

PARIOGRAPHIC INCORPOTION DEPORT WEI DUFUTE											CONTRACT NO. NNS POM-70200-R HULL N/A							
ADDIOGRAPHIC INSPECTION REPORT-WELDMENTS																		
										ITEM NO. 101.00 PAGE 1 of 1 Aluminum .125 QUANTITY 1								
ISS NO.WQ-OO1-A QUALITY LEVEL: 2-2T \(\text{ 2-4T} \)									T%	RT.			50% 10% SPOT					
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QA-RT-2

RADIOGRAPHER(S) Moore/Krofta

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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	C.30
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

E 3	OPERATING PARAMETERS: WELDING POS. HORIZONTAL NO. PASSES 1 PREHEAT 60 MIN INTERPASS TEMP.NA CURRENT CHARAC. D.C. R.P. CURRENT RANGE 85
QUALIFICATION JOINT	VOLTAGE RANGE 19.5
ATERIALS: ASE SPEC. QQ-A-250/6 5083 H-323	WIRE FEED IPM 245
ATL. THICKNESS, 125"	SHIELD FLOW 40 CFH
ILLER SPEC. AWS A5.10-80 ER 5556	TRAVEL SPEED 15 IPM
FILLER DIA. 3/64" HIELDING GAS 75%HE/25%AR	MAX. HEAT INPUT J/IN NA HEAT TREAT NA
LUX AND SIZE NA COUIPMENT:	
OWER SUPPLY AIRCO PA 350 ORCH OR HOLDER TYPE BINZEL SUP TYPE & SIZE METALLIC 3/4"	OTHER
ELECTRODE TYPE & SIZE NA	
DT TESTS:	RESULTS: Visual - No visible defects
X YIS, X PT UT X RT MT	
T TESTS: PLATE OR SPEC. SER. NO.	P.T. Acceptable - Report # 1615 attached
RST Sat. Report # E28426-8 HRDNS	R.T. Acceptable - Report # 7046 attached
CHARPY SIDE BEND	
ROOT BEND Sat. Report # E28426-8 FACE BEND Sat. Report # E28426-8	
FILLET BEND	
TRANS. SHEAR LONG SHEAR	
EXPL.BULGE OTHER	
EMARKS:	
1. HITCH HATCH 10879	J.C. JOHNSTON
ELD OPR. // CLOCK NO.	TEST BY QUAL. RANGE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 5-10-83						
TODD ORDER NO. 4787 . ITEM NO. 101.0	00 REPORT NO. 1615					
DYE PENETRANT NOND	ESTRUCTIVE TEST REPORT					
JOB DESCRIPTION MARAD PLATE GMAW SHORT ARC PROCESS						
FOR: TWPS No. C . 30	MATERIAL: Aluminum					
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15.20 min					
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.					
PER SPEC: MIL-STD-271 E , NAVSHIPS 090	00-003-8000, CLASS I					

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

SHIPYARDS CORPORATION

Seattle Division: 1801 15th Avenue, S.W.

QA-RT-2

Seattle, Weshington 98124 • 623-1635 (206)

REPORT NO. 7046

IADIOGRAPHIC INSPECTION REPORT-WELDMENTS							CONTRACT NO. NNS POM-70200-R HULL N/A										
											- 11	OB NO.4787			ITEM NO. 101.00 PAGE 1 of 1		
ISS	ISS NO. WQ-001-A QUALITY LEVEL: 2-2T \(\times \) 2-4T \(\times \)-% RT: 100% \(\times \) 50% \(\times \) 10% \(\times \) SPOT \(\times \)																
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FILM TYPE(S)	SFD(INCHES	(INCHESS)	SEGU	TIEM	ORIG. or	POROSITY	INCLUSIONS	INCOMPLETE PENETRATION	記記	CRACK	UNDERCUT	SURFACE	OTHER	C - 30	ACCEPT	REJECT	REMARKS
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SEATTLE DIVISION

WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST. SERIES NO	C.46
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/6 5083 H-323 MATL. THICKNESS .125" FILLER SPEC. AWS A5.10-80 ER 5356 FILLER DIA. 3/64" SHIELDING GAS 75%HE/25%AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZEMETALLIC 3/4" ELECTRODE TYPE & SIZE NA	OPERATING PARAMETERS: WELDING POSOVERHEAD NO. PASSES 1 PREHEAT60 MIN INTERPASS TEMPNA CURRENT CHARACD.C. R.P. CURRENT RANGE 105 VOLTAGE RANGE 15 WIRE FEED IPM_280 SHIELD FLOW_40 OPH TRAVEL SPEED20 IPM MAX. HEAT INPUT J/INNA HEAT TREATNA OTHER
NDT TESTS: X yis, X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-9 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-9 X FACE BEND Sat. Report # E28426-9 FILLET BEND FILLET BEND FILLET BREAK TRANS. SHEAR LONG SHEAR EXPL. BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1616 attached R.T. Acceptable - Report # 7047 attached
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J. JOHNSTON TEST BY QUAL. RANGE
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-10-83						
TODD ORDER NO. 4787 . ITEM NO.	101.00 REPORT NO. 1616					
DYE PENETRANT	NONDESTRUCTIVE TEST REPORT					
JOB DESCRIPTION						
MARAD PLATE	GMAW SHORT ARC PROCESS					
FOR: TWPS. C. 46	MATERIAL: Aluminum					
PENETRANT EQUIP. DUBL-CHEK; VISIBLE REI	D PENETRANT TIME: 15-20min.					
REPORTS TO: Distribution	DEVELOPMENT TIME : 7-30 min.					
PER SPEC: MIL-STD-271 E , NAVSHIPS	0900-003-8000, CLASS I					

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR B. Dyer R. Bell

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Weshington 98124 • 623-1635 (206)

REPORT NO. 7047

RADI	OGR	APHIC	INS	SPECTION	REP	ORT	-WEI	DME	ITS					CONTRA	CT N	0. <u>N</u>	NS POM-70200-R HULL N/A
OB	NAM	E TW	PS	NoC.4	6								J	OB NO. 478	37 -		ITEM NO.101.00 PAGE 1 of 1
DES	CRIP	TION	MAF	RAD PLAT	E												Aluminum .125 QUANTITY 1
	NO.	WQ -	001	_A		Ql	JALI	TY LI	VEL:	2.	2T.	X.	2-41	□% RT	100)% X] 50%□ 10%□ SPOT□
FILM TYPE(S)	SFD(INCHES)	ESS SJ	CE 30		REP.	ΤY	IONS	INCOMPLETE PENETRATION	LETE		19	ш		DISPOS	T		MIL- STD-271-E X NAVSHIPS 0900-003-9000,CLASS 1 ABS CLASS A CLASS B
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	SFD	THICKNESS (INCHES)			ORIG.or			35	35	S	UNDERCUT	SURFACE	OTHER	c.46	ACCEPT	REI	REMARKS
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WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO. D-8 PROCEDURE NO. **PROCESS GMAW** CONTRACT MARAD SP-7 DATE 12/1/83

WELDTIA (MOCEDOINE GOVER) 1941 1941 1941 1993)	14/1/05
QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/19 5086 H116 MATL. THICKNESS .250" FILLER SPEC. AWS A5.10-80 ER 5556 FILLER DIA. 3/64" SHIELDING GAS 75% HE/25% AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PULSE ARC 350 TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZE METALLIG 3/4" ELECTRODE TYPE & SIZE NA	OPERATING PARAMETERS: WELDING POS. VERTICAL-UP_NO. PASSES 1 PREHEAT 60 MIN. INTERPASS TEMP. NA CURRENT CHARAC. DC RP CURRENT RANGE 150 VOLTAGE RANGE 16 WIRE FEED IPM 362 SHIELD FLOW 40 CFH TRAVEL SPEED 11.5 IPM MAX. HEAT INPUT J/IN_NA HEAT TREAT_NA OTHER_NA
NDT TESTS: X YIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-12 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-12 Y FACE BEND Sat. Report # E28426-12 FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1621 attached R.T. Acceptable - Report # 7085 attached
	J.C.JOHNSTON TEST BY QUAL. RANGE MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE
AND THAT TESTING AND EVALUATION WAS CONDUCTED BELOW.	CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-19-83	
TODD ORDER NO. 4787 ITEM NO. 101.	00 REPORT NO. 1621
DYE PENETRANT NOND	DESTRUCTIVE TEST REPORT
JOB D	DESCRIPTION
MARAD PLATE GMA	W SHORT ARC PROCESS
FOR: TWPS No. D . 8	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900)-003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR B. Dyer R. Bell

2 | | |

REPORT NO.

Seattle Division: 1801 16th Avenue, S.W.

SHIPYARDS CORPORATION

Seattle, Weshington 98124 • 623-1635 (206)

DATES CONTRACT NO. RADIOGRAPHIC INSPECTION REPORT-WELDMENTS--HULL JOB NO. 4767 ITEM NO./0/00 PAGE OB NAME TELES DESCRIPTION MARK SMAKL SHURTARL MAT'LAL 114 QUALITY LEVEL: 2-2T □ 2-4T □ --% RT: 100% ☑ 50% □ 10% □ SPOT □ MIL- STD-271-E DISPOSITION NAVSHIPS 0900-003-9000, CLASS . ABS CLASS A CLASS B

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FILM SIZE AND QUANTITY NO.OF VIEWS 41/2×17 41/2×10

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RADIOGRAPHER(S) / QA-RT-2

APPROVED BY ____ Seece

ACCEPTED BY___

120

PACIFIC	SHIPYAR	708 CO	RPORAT	NOI.

SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

D-10 TEST SERIES NO._ PROCEDURE NO. PROCESS **GMAW** CONTRACT MARAD SP-7 DATE 12/1/83

QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/19 5086 H-116 MATL. THICKNESS .250" FILLER SPEC. AWS A5.10-80 ER 5556 FILLER DIA. 3/64" SHIELDING GAS HELIUM 100% FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY ATROD PULSE ARC 350 TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZE METALLIC 3/4" ELECTRODE TYPE & SIZE NA NDT TESTS: X VIS. X PT UT X RT MT	OPERATING PARAMETERS: WELDING POS_HORIZONTAL_NO. PASSES_1 PREHEAT_60 MIN. INTERPASS TEMP. NA CURRENT CHARAC. DC RP CURRENT RANGE_149 VOLTAGE RANGE_149 VOLTAGE RANGE_14.5 WIRE FEED IPM_327 SHIELD FLOW_100 GFTH. TRAVEL SPEED_8.4 IPM MAX. HEAT INPUT J/IN_NA HEAT TREAT_NA OTHER_NA RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1649 attached
DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28635-3 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28635-3 X FACE BEND Sat. Report # E28635-3 FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	P.T. Acceptable - Report # 1649 attached R.T. Acceptable - Report # 7106 attached
REMARKS:	
17(74)	
JON H. HITCH A LILL 10879 WELD OPR. CLOCK NO.	JAMES C. JOHNSTON TEST BY QUAL. RANGE
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 6-10-83	
TODD ORDER NO. 4787 . ITEM NO. 101.0	0 REPORT NO. 1649
DYE PENETRANT NONDI	ESTRUCTIVE TEST REPORT
	DESCRIPTION SHORT ARC PROCESS
FOR: TWPS No. D - 10	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
DED SDEC: MIL-STD-271 F NAVSHIPS 090	0-003-8000 CLASS T

CONTRACT NO. NNS POM70200-R

Liquid penetrant inspection of weld was found to be acceptable.

SHIPYARDS CORPORATION .

Seattle Divisient 1801 16th Avenue, S.W.

Seettle, Weshington 98124 • 623-1635 (206)

REPORT NO. 7/06 DATE 6 FF 3

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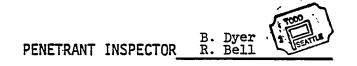
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TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-10-83	
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1608
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT
JOB DE	SCRIPTION
MARAD PLATE GMAW	SHORT ARC PROCESS
FOR: TWPS NO. E-7	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	-003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.



SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Weshington 98124 • 623-1635 (206)

REPORT NO. 7048

DATE 5/9/83

RADI	OGR	APHIC	INS	SPECTION	REP	ORT	WE	DMEN	ITS					CONTRA	CT N	0. N	NS POM 70200-R HULL N/A
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				RAD PLAT		GM/	W.	HORT	AR	C P	ROC	ESS	3		N	I'TAF	Aluminum .250 QUANTITY 1
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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	E-33	
PROCEDURE NO.		
PROCESS	GMAW	
CONTRACT	MARAD SP-7	
DATE	12/1/83	_

ETDING (MOCEDOINE GOVER) TOUR LEGIT CO.)	MRI DATE
VELDING PROCEDURE QUALIFICATION TEST SOLITION TO THE STATE OF THE SOLITION TEST SOLITI	OPERATING PARAMETERS: WELDING POS. HORIZONTAL NO. PASSES 1 PREHEAT 60 MIN. INTERPASS TEMP. NA CURRENT CHARAC. DC RP CURRENT RANGE 156
QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/19 5456 H116 MATL. THICKNESS .250" FILLER SPEC. AWS A5.10-80 ER 5556 FILLER DIA. 3/64 INCH SHIELDING GAS 100% HELIUM FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PULSE ARC 350 FORCH OR HOLDER TYPEBINZEL CUP TYPE & SIZE METALLIC3/4" ELECTRODE TYPE & SIZE NA	WIRE FEED IPM 343 SHIELD FLOW 100 CFH TRAVEL SPEED 8.9 TPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER NA
X VIS. X PT UT X RT MT OT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28635-2 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28635-2 X FACE BEND Sat. Report # E28635-2 FILLET BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1650 attached R.T. Acceptable - Report # 7109 attached
JON H. HITCH 10879 WELD OPR. CLOCK NO.	JAMES C. JOHNSTON TEST BY QUAL. RANGE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALTY ASSURANCE DEPARTMENT

DATE	6-10-83	

TODD ORDER NO. 4787 . ITEM NO. 101.00 REPORT NO. 1650

DYE PENETRANT NONDESTRUCTIVE TEST REPORT

JOB DESCRIPTION

MARAD PLATE GMAW SHORT ARC PROCESS

FOR: TWPS NO. E -33MATERIAL: Aluminum PENETRANT EQUIP. DUBL-CHEK; ,VISIBLE RED PENETRANT TIME: 15-20 min. REPORTS TO: Distribution DEVELOPMENT TIME: 7-30 min. PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-003-8000, CLASS I

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

TODD SHIPYARDS CORPORATION

			Se	ettie Di	visio	x 180	11 16	ith An	remue,	S.W.	5	Seatt	ie, W	nahi r	igton 98124 •	62	23-163	15 (204) REPORT NO. 7/09
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SEATTLE DIVISION

F-3	
GMAW	
MARAD SP-7	
12/1/83	
	GMAW MARAD SP-7

WELDING PROCEDURE QUALIFICATION TEST SUMMA	ARY DATE <u>12/1/83</u>
QUALIFICATION JOINT MATERIALS: BASE SPEC. OO-A-250/6 5083 H-321 MATL. THICKNESS_250" FILLER SPEC. AWS A5.10-80 ER 5556 FILLER DIA. 3/64" SHIELDING GAS 75% HE/25% AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PULSE ARC 350 TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZE METALLIC 3/4" ELECTRODE TYPE & SIZE NA	OPERATING PARAMETERS: WELDING POS. VERTICAL-UP NO. PASSES 1 PREHEAT 60° MIN. INTERPASS TEMP. NA CURRENT CHARAC. DC RP CURRENT RANGE 130 VOLTAGE RANGE 15.7 WIRE FEED IPM 330 SHIELD FLOW 40 CFH TRAVEL SPEED 12 IPM MAX. HEAT INPUT J/IN HEAT TREAT NA
NDT TESTS: X yrs. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E28426-14 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E28426-14 X FACE BEND Sat. Report # E28426-14 FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1622 attached R.T. Acceptable - Report # 7087 attached
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J.C. JOHNSTON TEST BY QUAL. RANGE
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE5-19-83	
TODD ORDER NO. 4787 ITEM NO. 101	.00 REPORT NO. 1622
DYE PENETRANT NON	NDESTRUCTIVE TEST REPORT
JOB	DESCRIPTION
MARAD PLATE GM	AW SHORT ARC PROCESS
FOR: TWPS No. F . 3	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271_E , NAVSHIPS	0900-003-8000, <u>CLA</u> SS I

CONTRACT NO. NNW POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

2 CENTRE

PACIFIC	SHIPYAF	ros cof	RPORATION	1

SEATTLE DIVISION WELDING PROCEDURE OUALIFICATION TEST SUMMARY

TEST SERIES NO	F-13	
PROCEDURE NO.		_
PROCESS	GMAW	_
CONTRACT	MARAD SP-7	_
DATE	12/1/83	_

WELDING PROCEDURE QUALIFICATION TEST SUMMA	RY. DATE	12/1/83
ASO ASO ASO ASO ASO ASO ASO ASO	OPERATING PARAMETERS WELDING POS. HORIZON PREHEAT 60° MIN. CURRENT CHARAC. D CURRENT RANGE 145 VOLTAGE RANGE 14.5 WIRE FEED IPM 333 SHIELD FLOW 1.00 TRAVEL SPEED 10.2 MAX. HEAT INPUT J/IN HEAT TREAT NA OTHER NA RESULTS: Visual - No visible P.T. Acceptable - I	TAL. NO. PASSES 1 INTERPASS TEMP. NA C RP CFH IPM NA
REMARKS:	,	
JON H. HITCH X 10879 WELD OPR. CLOCK NO.	JAMES C. JOHNSTON TEST BY	QUAL. RANGE
THIS CERTIFIES THAT THE DATA HEREIN IS CONDUCTION WAS CONDUCTED THAT TESTING AND EVALUATION WAS CONDUCTED.		

TODD SHIPYARDS CORPORATION SEATTLE DIVISION OUALITY ASSURANCE DEPARTMENT

DATE	6-10-83	
1)A.I.H:	0-10-03	

TODD ORDER NO. 4787 . ITEM No. 101.00 REPORT NO. 1648

DYE PENETRANT NONDESTRUCTIVE TEST REPORT

JOB DESCRIPTION MARAD PLATE GMAW SHORT ARC PROCESS FOR: TWPS No. F -13 MATERIAL: Aluminum PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED PENETRANT TIME: 15-20 min. REPORTS TO: Distribution DEVELOPMENT TIME: 7-30 min. PER SPEC: MIL-STD-271 E, NAVSHIPS 0900-003-8000 CLASS I

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

B. Dyer R. Bell

PENETRANT INSPECTOR R. Bell

SHIPYARDS CORPORATION .

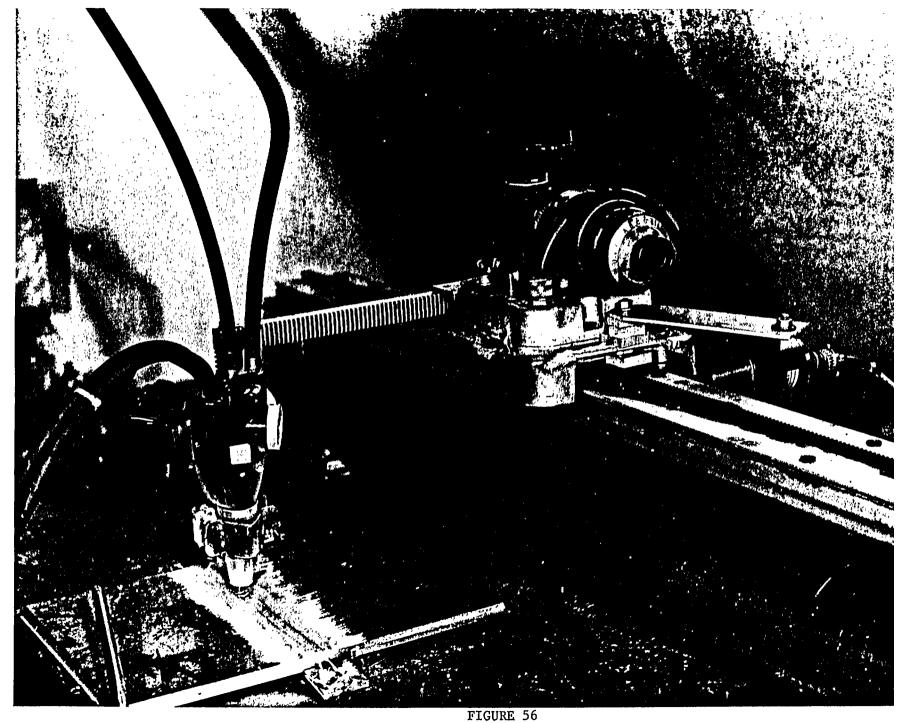
Seattle, Washington 98124 • 623-1635 (206) REPORT NO. 7//
DATE 67 Seettle Divisient 1801 16th Avenue, S.W. **!ADIOGRAPHIC INSPECTION REPORT-WELDMENTS--**CONTRACT NO. HULL AM OB NAME TULES ITEM NO/0/00 PAGE PLT-FMAINSHORTARC MAT'LA6-114" QUANTITY QUALITY LEVEL: 2-21 ☑ 2-47 ☐ --% RT: 100% ☑ 50% ☐ 10% ☐ SPOT ☐ MIL- STD-271-E DISPOSITION NCLUSIONS NAVSHIPS 0900-003-9000,CLASS __ POROSITY ABS CLASS A CLASS B PENET NCOM FUSION OTHER: VIEW **JOINT** REMARKS CODE ACCEPTABLE **RADIATION SOURCE:** BORDERLINE X-RAY: KV # PREPARED BY EXCESSIVE IR-192: CURIES __ APPROVED BY. SINGLE FILM 🔀 FILM SIZE AND QUANTITY NO.OF VIEWS 41/2×17 41/2×10 MULTIFILM ACCEPTED BY_ BOTH RADIOGRAPHER(S) QA-RT-2 154

MECHANIZED PULSE ARC WELDING : FLAT POSITION

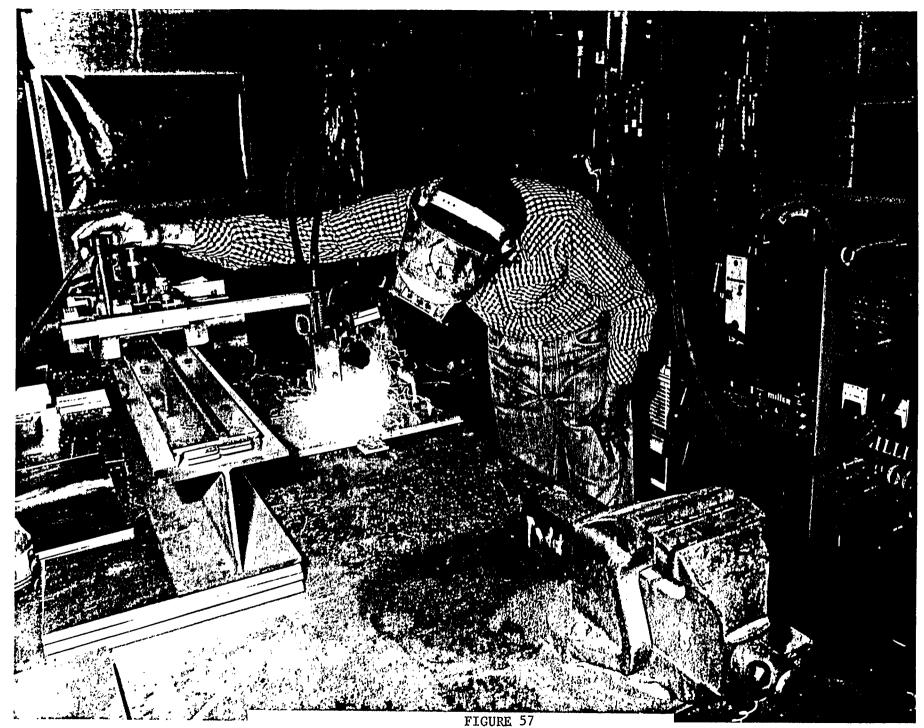
5083 H-321 ALUMINUM ALLOY PLATE: .500 INCH THICKNESS ER 5356 ALUMINUM ALLOY FILLER WIRE; MILLER PULSTAR 450

Mechanized flat position, one-side, full penetration gas metal arc butt welding of .500 inch thick 5083 H-321, QQ-A-250/6 was accomplished with the use of a "BUG-O" tractor, Model 2000, with a post-mounted Airco AH 35-C2 water cooled torch. An Airco AHF-NP feeder was used in conjunction with a Miller Pulstar 450. The welding filler wire was 3/64 inch diameter 5356 aluminum alloy. Shielding gas used was 75% helium/25% argon. Acceptable non-destructive test results and mechanical properties data were attained. Weld procedure qualification data and specific welding machine settings are reported in their respective sections. A typical mechanized pulse arc welding set-up for flat position welding is illustrated in Figure 56. A mechanized pulse arc welding of test panel is shown in Figure 57. A mechanized pulse arc welding root bead in .500 inch thick 5083 H-321 aluminum alloy plates is illustrated in Figure 58. Weld bead surfaces and also under-beads are shown in Figures 59 and 60.

A limited number of .063 to .250 inch thick 5000 series aluminum alloy materials were butt welded into test panels with the use of mechanized pulse gas metal arc welding in the flat position. These panels were subsequently non-destructively inspected per the penetrant and radiographic test requirements exclusively, i.e. without destructive testing for mechanical properties. Acceptable machine settings which were established with the use of other pulse GMAW welding power sources and accessories are covered in the following section entitled "Pulse Arc Weld Machine Settings".

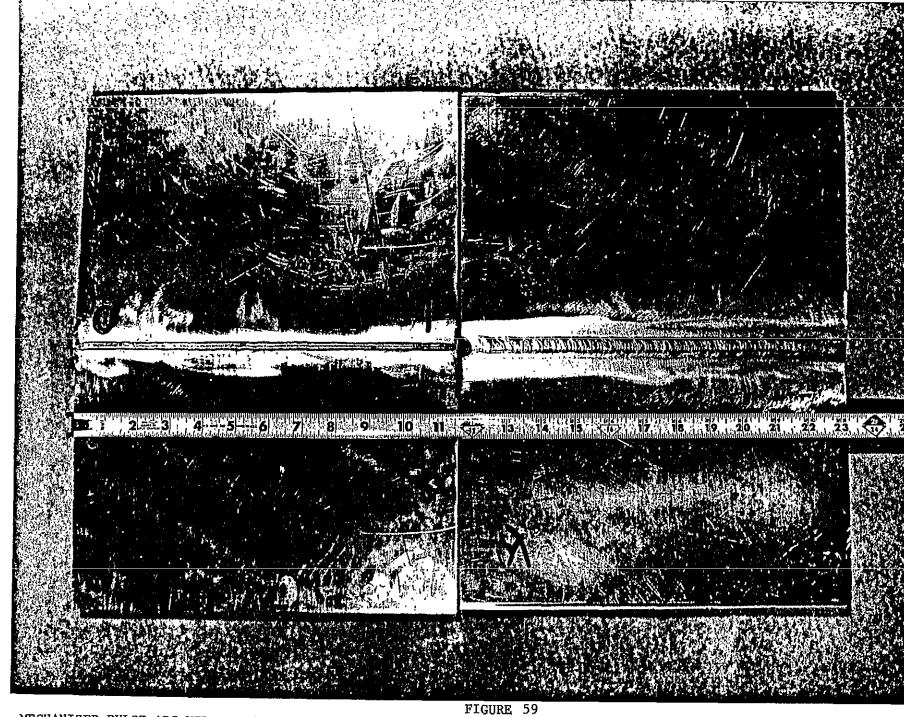


TYPICAL MECHANIZED PULSE ARC WELDING SET-UP: FLAT POSITION, ONE-SIDE, FULL PENETRATION BUTT WELDS

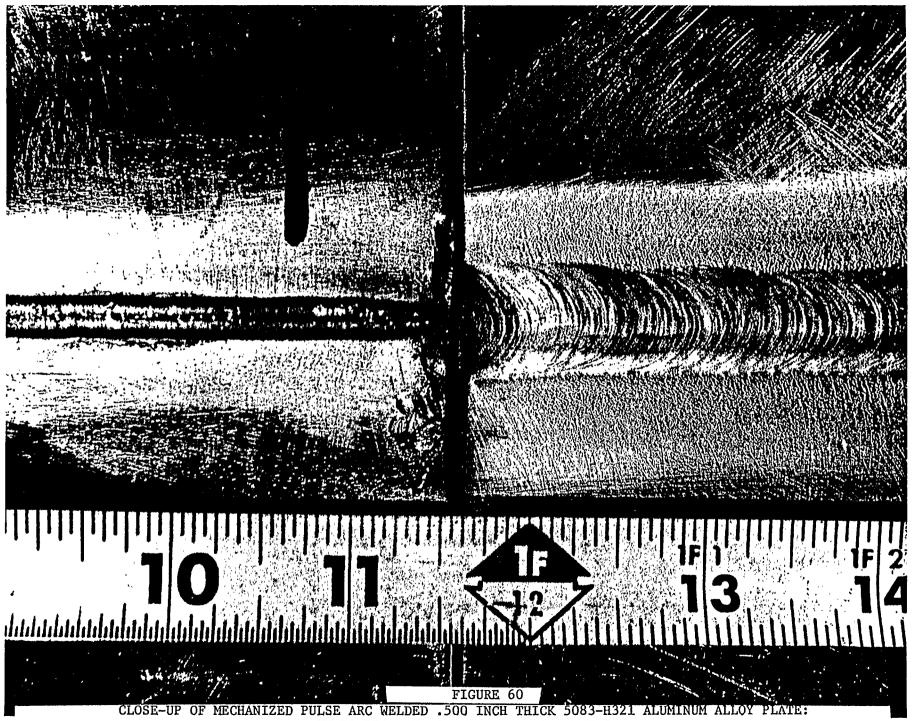


TYPICAL MECHANIZED PULSE ARC WELDING





MECHANIZED PULSE ARC WELDED .500 INCH THICK 5086-H321 ALUMINUM ALLOY PLATE: UNDER-BEAD & SURFACE REINFORCEMENTS



UNDER-BEAD AND SURFACE REINFORCEMENTS



SEATTLE DIVISION

WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO.	A1.34
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

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QUALIFICATION JOINT MATERIALS: BASE SPEC. 5086 H-32	OPERATING PARAMETERS: WELDING POS. FLAT NO. PASSES 1 PREHEAT 60 F MIN. INTERPASS TEMP. NA CURRENT CHARAC. DCRP CURRENT RANGE 50 VOLTAGE RANGE 13.5 WIRE FEED IPM 130 SHIELD FLOW 40 CFH TRAVEL SPEED 24.5 TPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER "BUG-O" CARRIAGE WITH POST MOUNTED TORCH 60 PPS RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1861 attached R.T. Acceptable - Report # 7220 attached
CHARPY SIDE BEND ROOT BEND FACE BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	
REMARKS:	
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J.C. JOHNSTON TEST BY QUAL. RANGE
THIS CERTIFIES THAT THE DATA HEREIN IS CON AND THAT TESTING AND EVALUATION WAS CONDUCT BELOW.	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT.

DATE 11-21-83	•
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1861
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT
JOB DE	SCRIPTION
MARAD PLATE GMAW	PULSED ARC PROCESS
FOR: TWPS No. Al. 34, B.77, C.65, C.67	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable, for each plate.

PENETRANT INSPECTOR T. Moore

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7220 DATE 11-21- 93

ADIOGRAPHIC INSPECTION REPORT-WELDMENTS												CONTRACT NO. NNS DOM 76200-R HULL N7A									
IB NAME MARAD R & D PROJEC											cī										
ESCRIPTION PROCEDURE PLATES												MAT'L ALUM QUANTITY ←/ IT ☑ 2-4T □% RT: 100% ☑ 50% □ 10% □ SPOT □									
<u>SS</u>	NO.	<u>5-</u>	A	<u> </u>		QL	IALI	TY LE	YEL:	2-	2T [<u>x</u>	2-47	[<u> </u>	·% RT	: 100	1% ≥			
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RA	RADIOGRAPHER(S) T. MOORE																				

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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO.	B.77
PROCEDURE NO.	
PROCESS	GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

MELDING (NOCEDOINE GONET) TON 1201 (1201 201)	12/1/05	•
	ODEDATING DADAMETEDS.	
<u>*</u> *	OPERATING PARAMETERS: WELDING POS. FLAT NO. PASSES 1 PREHEAT 60 F MIN. INTERPASS TEMP. NA CURRENT CHARAC. DCRP CURRENT RANGE 60	
QUALIFICATION JOINT	VOLTAGE RANGE 16,5	
MATERIALS: BASE SPEC. 00-A-150/7 5086 H-32 MATL. THICKNESS _100" FILLER SPEC. AWS A5.10-80 ER 5356 FILLER DIA. 3/64" SHIELDING GAS _75% HE/25% AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY GILLILAND CV 600 FI-PA TORCH OR HOLDER TYPE MTG 4001 CUP TYPE & SIZE _ 3/4" METALLIC ORIFICE ELECTRODE TYPE & SIZE _ NA	WIRE FEED IPM 150 SHIELD FLOW 40 CFH TRAVEL SPEED 22 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER "BUG-O" CARRIAGE WITH POST MOUNTED 60 PPS	TOR
NDT TESTS: X VIS, X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. RST HRDNS CHARPY SIDE BEND ROOT BEND FACE BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1861 attached R.T. Acceptable - Report # 7220 attached	
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J.C.JOHNSTON TEST BY QUAL. RANGE	
THIS CERTIFIES THAT THE DATA HEREIN IS CO	OMPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE UCTED IN ACCORDANCE WITH THE REQUIREMENTS LIST	
	WELDING ENGINEER DATE	

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE_11-21-83	•
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1861
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT
JOB DE	SCRIPTION
MARAD FLATE GMAW	PULSED ARC PROCESS
FOR: TWPS No. Al. 34, B.77, C.65, C.67	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable, for each plate.

PENETRANT INSPECTOR T. Moore

QA-PT-

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7220

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	ADIOGRAPHER(S) T. MOORE																



SEATTLE DIVISION

WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO.	C.67 C.65
PROCEDURE NO.	
PROCESS	CMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

QUALIFICATION JOINT MATERIALS: BASE SPEC. 5083 H=323	OPERATING PARAMETERS: WELDING POS. FLAT NO. PASSES 1 PREHEAT 60 F MIN. INTERPASS TEMP. NA CURRENT CHARAC. DCRP CURRENT RANGE 68 VOLTAGE RANGE 18.6 WIRE FEED IPM 175 SHIELD FLOW 40 CFH. TRAVEL SPEED 16.2 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER "BUG-O" CARRIAGE WITH POST MOUNTED TORCH. 60 PPS RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1861 attached R.T. Acceptable - Report # 7220 attached
TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER REMARKS:	
J.H. HITCH 10879 WELD OPR. CLOCK NO.	J.C. JOHNSTON TEST BY QUAL. RANGE
	MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE CTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE_11-21-83	
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1861
DYE PENETRANT NONDES	STRUCTIVE TEST REPORT
JOB DES	SCRIPTION .
MARAD PLATE GMAW	PULSED ARC PROCESS
FOR: TWPS No. Al. 34, B.77, C.65, C.67	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable, for each plate.

PENETRANT INSPECTOR T. Moore

QA-PT-

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7220

DIOGRAPHIC INSPECTION REPORT-WELDMENTS									ITS			CONTRA	CT N	l0. <i>№</i>	DATE 11-21- 9 US DOM 76200-R HULL N/A					
	SCRIPTION PROCEDURE PLATES									JE	cī		j	JOB NO. 47 87 ITEM NO. 101.00 PAGE 101						
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SEATTLE DIVISION

TEST SERIES NO. C.68, C.69, C.70 PROCEDURE NO. PROCESS PULSE GMAW, MECHANIZED CONTRACT MARAD SP-7

WELDING PROCEDURE QUALIFICATION TEST SUMMY	ARY DATE <u>12/1/83</u>
<u> </u>	OPERATING PARAMETERS: WELDING POS. FLAT NO. PASSES 1 PREHEAT 60F MIN. INTERPASS TEMP. NA CURRENT CHARAC. DCRP CURRENT RANGE 70
QUALIFICATION JOINT MATERIALS: BASE SPEC. 5083 H-323	WIRE FEED IPM 170 SHIELD FLOW 40 CFH TRAVEL SPEED 16.1 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA
EQUIPMENT: POWER SUPPLY MILLER PULSTAR 450 TORCH OR HOLDER TYPE AH 35 C-2 CUP TYPE & SIZE 3/4" METALLIC ELECTRODE TYPE & SIZE NA	OTHER "BUG-O" CARRIAGE WITH POST MOUNTED TORC
NDT TESTS: X VIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. RST HRDNS CHARPY SIDE BEND ROOT BEND FACE BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1871 attached R.T. Acceptable - Report # 7226 attached
J.H. HITCH A HITCH 10879	J.C. JOHNSTON
	TEST BY QUAL. RANGE OMPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE DICTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED Common C
	WELDING ENGINEER DATE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE11-28-83	
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1871
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT
JOB DE	SCRIPTION
MARAD PLATE GMAW	PULSED ARC PROCESS
FOR: TWPS No. C.68, C.69, C.70	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable, for each of the welds inspected.

PENETRANT INSPECTOR

J. Posten

QA-PT-



SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT	NO.	12	.26

	ADIOGRAPHIC INSPECTION REPORT-WELDMENTS											CONTRACT NO. NNS-POM-70200-RHULL N/A						
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ACCEPTABLE BORDERLINE EXCESSIVE SINGLE FILM STEAM QUANTITY VIEWS 4½×17 4½×10 RADIATION SOURCE: X-RAY: KV 200 mA / 2 PREPARED BY APPROVED BY ACCEPTED BY																		•
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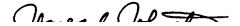
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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES N	0. D-25
PROCEDURE NO.	
PROCESS GMAW	MECHANIZED PULSE
CONTRACT	MARAD SP-7
DATE	12/1/83

QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/19 5086 H-116 MATL. THICKNESS .250" FILLER SPEC. ER 5556 AWS A5.10-80 FILLER DIA. 3/64" SHIELDING GAS 100% Helium FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY MILLER PULSTAR 450 TORCH OR HOLDER TYPE AIRCO AH NP 35 CUP TYPE & SIZE METALLIC 3/4" ELECTRODE TYPE & SIZE NA NDT TESTS: X VIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. RST HRDNS CHARPY SIDE BEND FOLLET BEND FILLET BEND FILLET BEND FILLET BEAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	OPERATING PARAMETERS: WELDING POS. FLAT NO. PASSES 2 PREHEAT 60F MIN. INTERPASS TEMP. 300 F MAX. CURRENT CHARAC.DCRP CURRENT RANGE 105 105 VOLTAGE RANGE 23 24 WIRE FEED IPM 355 380 SHIELD FLOW 40 CFH TRAVEL SPEED 16 IPM 12.2 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER "BUGO" CARRIAGE WITH POST MOUNTED TORCH 120 PPS RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1850 attached R.T. Acceptable - Report # 7182 attached
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REMARKS:	
14/4	
J. HITCH Affile 10879	J.C. JOHNSTON
WELD OPR. CLOCK NO.	TEST BY QUAL. RANGE

THIS CERTIFIES THAT THE DATA HEREIN IS COMPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE AND THAT TESTING AND EVALUATION WAS CONDUCTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED BELOW.



TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 10-24-83	
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1850
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT
JOB DE	SCRIPTION
MARAD PLATE GMAW	PULSE PROCESS
FOR: TWPS No. D-25	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

G. Miller J. Posten R. Bell

PENETRANT INSPECTOR

TODD

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7182

ADIOGRAPHIC INSPECTION REPORT-WELDMENTS										CONTRACT NO. NNS POM-70200-R HULL N/A					4 <u>-83</u>				
ìВ	B NAME TWPS No. D-25										OB NO. 478	7		ITEM NO. 101.00		of 1			
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SEATTLE DIVISION

WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES	VOD-28
PROCEDURE NO	•
PROCESS	MECHANIZED PHISE GMAW
CONTRACT	MARAD- SP-7
DATE	12/1/83

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QUALIFICATION JOINT MATERIALS: BASE SPEC. OQ-A-250/19 5086 H-116 MATL. THICKNESS.250" FILLER SPEC. AWS A5.10-80 ER 5356 FILLER DIA. 3/64" SHIELDING GAS 75% HE/25% AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY AIRCO PA 350 TORCH OR HOLDER TYPE BINZEL CUP TYPE & SIZE 3/4" METALLIC ELECTRODE TYPE & SIZE NA	OPERATING PARAMETERS: WELDING POSFLATNOPASSES2 PREHEAT60F_MININTERPASS_TEMP300F_MAX CURRENT_CHARACDCRP CURRENT_RANGE92124 VOLTAGE_RANGE24.826.5 WIRE_FEED_IPM234314 SHIELD_FLOW40_CFH TRAVEL_SPEED12.216_IPM MAXHEAT_INPUT_J/INNA HEAT_TREATNA OTHER"BUG_O"_CARRIAGE_WITH_POST_MOUNTED_TORCH_ELECTRONICALLY_PROGRAMMED_WIRE_FEED
NDT TESTS: X YIS, X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. RST HRDNS CHARPY SIDE BEND ROOT BEND FACE BEND FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1851 attached R.T. Acceptable - Report # 7181 attached
J. HITCH 10879 WELD OPR. CLOCK NO.	J.C. JOHNSTON TEST BY QUAL. RANGE

THIS CERTIFIES THAT THE DATA HEREIN IS COMPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE AND THAT TESTING AND EVALUATION WAS CONDUCTED IN ACCORDANCE WITH THE REQUIREMENTS LISTED BELOW.

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE 10-24-83						
TODD ORDER NO. 4787 . ITEM NO. 101.00	REPORT NO. 1851					
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT					
JOB DE	SCRIPTION					
MARAD PLATE GMAW	PULSE PROCESS					
FOR: TWPS No. D-28	MATERIAL: Aluminum					
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.					
REPORTS TO: Distribution DEVELOPMENT TIME: 7-30 min.						
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	003-8000, CLASS <u>I</u>					

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

G. Miller

PENETRANT INSPECTOR R. Bell

J. Posten R. Bell

SHIPYARDS CORPORATION

Seattle Division: 1801 16th Avenue, S.W.

Seattle, Washington 98124 • 623-1635 (206)

REPORT NO. 7181

ADIOGRAPHIC INSPECTION REPORT-WELDMENTS									ITS			_		IS POM 70200-R HULL N/A				
)B NAME TWPS - D-28											J	OB NO. 478			ITEM NO. 101.00 PAGE 1 of 1			
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SEATTLE DIVISION WELDING PROCEDURE QUALIFICATION TEST SUMMARY

TEST SERIES NO	I-10
PROCEDURE NO.	
PROCESS	MECHANIZED PULSE GMAW
CONTRACT	MARAD SP-7
DATE	12/1/83

QUALIFICATION JOINT MATERIALS: BASE SPEC. QQ-A-250/6 5083-H321 MATL. THICKNESS ½ INCH FILLER SPEC. AWS A5.10-80 ER 5356 FILLER DIA. 3/64 INCH SHIELDING GAS 75% HE/25% AR FLUX AND SIZE NA EQUIPMENT: POWER SUPPLY MILLER PULSTAR 450 TORCH OR HOLDER TYPE AH 35 C-2 CUP TYPE & SIZE 3/4" METALLIC ORIFICE ELECTRODE TYPE & SIZE NA	OPERATING PARAMETERS: WELDING POSFLAT NO. PASSES 3 PREHEAT 60F MIN. INTERPASS TEMP. 300F MAX. CURRENT CHARAC. DCRP CURRENT RANGE 150 160 157 VOLTAGE RANGE 25 28 28 WIRE FEED IPM 375 400 390 SHIELD FLOW 40 CFH TRAVEL SPEED 14 11.5 11.5 IPM MAX. HEAT INPUT J/IN NA HEAT TREAT NA OTHER "BUG-O" CARRIAGE WITH POST MOUNTED TORCE 120 pps
NDT TESTS: X VIS. X PT UT X RT MT DT TESTS: PLATE OR SPEC. SER. NO. X RST Sat. Report # E29361 HRDNS CHARPY SIDE BEND X ROOT BEND Sat. Report # E29361 X FACE BEND Sat. Report # E29361 FILLET BEND FILLET BREAK TRANS.SHEAR LONG SHEAR EXPL.BULGE OTHER	RESULTS: Visual - No visible defects P.T. Acceptable - Report # 1848 attached R.T. Acceptable - Report # 7173 attached
J.H. HITCH CLOCK NO.	J.C. JOHNSTON TEST BY QUAL. RANGE MPLETE AND ACCURATE TO BEST POSSIBLE KNOWLEDGE

TODD SHIPYARDS CORPORATION SEATTLE DIVISION QUALITY ASSURANCE DEPARTMENT

DATE October 19, 1983	
TODD ORDER NO. 4787 . ITEM NO. 101.0	o REPORT NO. 1848
DYE PENETRANT NONDE	STRUCTIVE TEST REPORT
. JOB DE	SCRIPTION
MARAD PLATE GMAW	PULSE PROCESS
FOR: TWPS No. I-10 - Flat	MATERIAL: Aluminum
PENETRANT EQUIP. DUBL-CHEK; VISIBLE RED	PENETRANT TIME: 15-20 min.
REPORTS TO: Distribution	DEVELOPMENT TIME: 7-30 min.
PER SPEC: MIL-STD-271 E , NAVSHIPS 0900-	-003-8000, CLASS <u>I</u>

CONTRACT NO. NNS POM 70200-R

Liquid penetrant inspection of weld was found to be acceptable.

PENETRANT INSPECTOR R. Bell

TODD

SHIPYARDS CORPORATION

Seettle Division: 1801 16th Avenue, S.W.

PA-PT-2

Seattle, Washington 96124 • 623-1635 (206)

REPORT NO. 7173

AD!	ADIOGRAPHIC INSPECTION REPORT-WELDMENTS									CONTRACT NO.NNS-POM-70200-R HULL N/A							
	B NAME TWPS No. I-10 5083 H 321									I	OB NO. 478			ITEM NO. 101.00 PAGE 1 of 1			
				AD PLATE				ULSI			SS						ALUM. 1/2" QUANTITY 1
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CHIPPING

The chipping gun is still the preferred tool for removing excessive weld penetration reinforcement on the second side. The method still offers the fastest cuts and best grooves for removing weld defects and preparing for repair welding.

Excessive reinforcements on the torch side (first side) and the back side (second side) maybe removed with the use of a flat configuration chisel and should be worked to the high side of the weld butt joint so that the base material thickness will not be reduced. In general, the other half of the weld joint will fair in smoothly by itself.

Flat "V" and spoon shape chisels were made per sample from 401 Parker taper shanks. All chisels were approximately 6 inches long x 13/32 inches diameter shank blanks. Figures 61 and 62 illustrate the flat "V" and spoon configurations of chisels used.

Figure 63 is a photograph of the three chisel configurations.

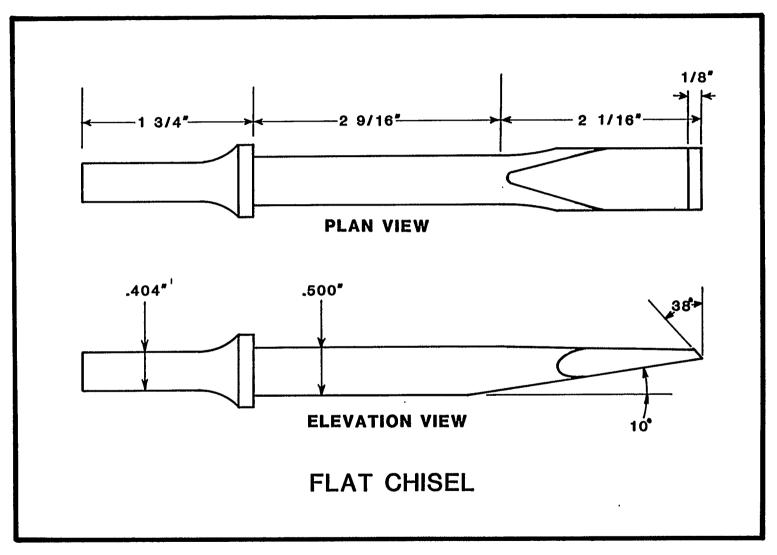


FIGURE 61
FLAT CHISEL CONFIGURATION

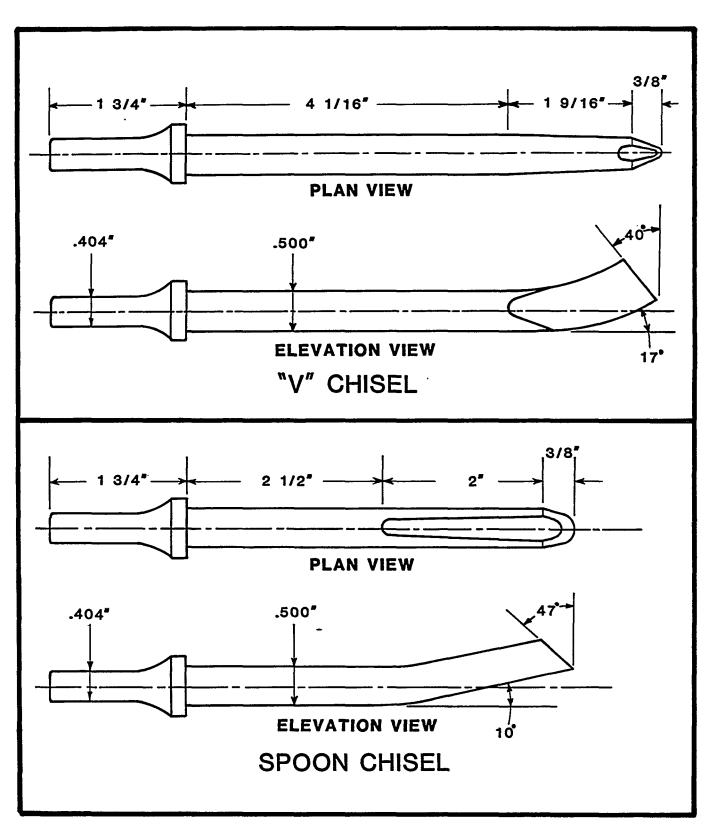


FIGURE 62
CHISEL CONFIGURATIONS

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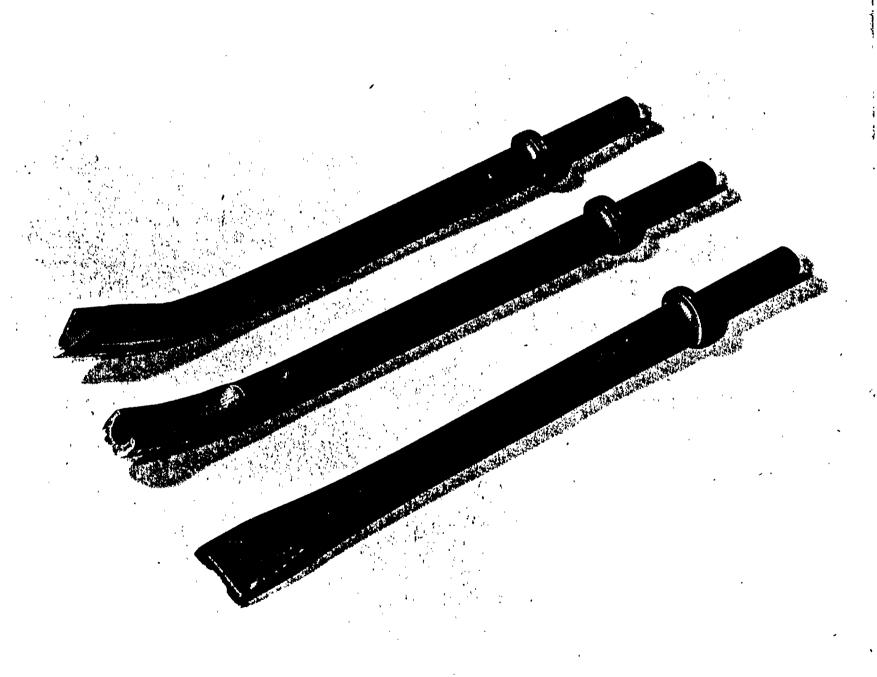


FIGURE 63

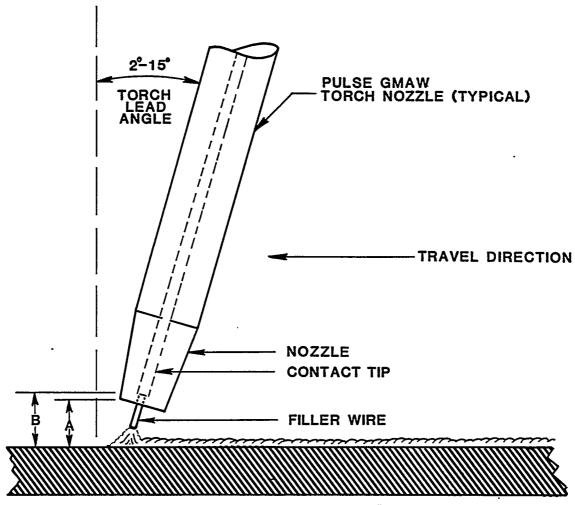
WELDING TECHNIQUE

In general, the preferred welding technique was to run stringer bead welds in the root passes when using either the pulse spray or the "pulse short-circuiting mode". Single pass stringer bead welds were made in material thicknesses up to 1/4 inch. However, because of longer periods at temperatures involved, single pass welds should be limited to 1/8 inch maximum thickness.

When certified weld machine settings are established for sheet material under .125 inch thickness and when spatter and heat are minimized in the "pulse short-circuiting mode", it is feasible to weld all positions without the use of heavy leather gloves generally used for shielded metal arc welding.

It should be pointed out that the intent of the above statement relative to the feasibility of using bare hands pertains only to illustrate a welding condition of no spatter and should not be interpreted as justification towards violation of existing and established AWS and shipyard safety requirements to wear gloves for any type of welding.

Torch position and angles relative to the work piece and direction of travel were very similar to conventional gas metal arc welding. It appeared that torch positions and angles were less critical for the pulsed GMAW mode. See Figure 64 for sketch illustrating torch position and torch angle tolerances.



NOTE: A CUP-TO-WORK DISTANCE 3/8"- 3/4"

B CONTACT TIP-TO-WORK DISTANCE 1/2"- 3/4"

FIGURE 64

MANUAL PULSE GMAW
TORCH POSITION; TORCH ANGLES; CUP/CONTACT TIP TO-WORK DISTANCES

REPAIR WELDING

Only one repair with gas metal arc welding is allowed per MIL-STD-248 on all procedure qualification test panels. All repairs should be made in the same manner as the original weld, i.e. implementing the same welding power sources and accessories, welding position and original standard. Although no repairs were required on the test panels submitted for visual and radiographic inspection, it appears that standard repair techniques could be applied very readily.

When full penetration welds are deposited from one side, lack of fusion type defects are uncommon. On the other hand, incomplete fusion and lack of fusion are rather common when aluminum plate/sheet is welded from two sides, i.e. when the root weld beadc(s) from the first side do not interpenetrate with the root beads from the second side, lack of fusion on the joint side walls are common defects.

Incomplete weld penetration is usually caused because the welding current is too low or welding travel speed is too fast.

Incomplete weld penetration is a significantly disastrous defect. Full penetration welds on the side opposite the gas metal arc torch may be visually inspected readily for incomplete penetration.

PREHEAT , INTERPASS , AND POST-HEAT TEMPERATURES

In general, no preheat is required except to remove moisture. A gentle soot free oxy-gas torch flame or strip heaters may be used to provide uniform temperature not exceeding 300F for tempered condition of 5000 series aluminum alloys for marine fabrication. Preheat temperatures may be measured with a surface pyrometer or other suitable temperature indicating devices.

Interpass temperatures should be kept as low as feasible.

Since 5000 series aluminum alloys are not heat treatable, no post-heat requirement is necessary.

MECHANICAL PROPERTIES FOR 5000 SERIES ALUMINUM ALLOY SHEET AND PLATE BUTT WELDS (AS-WELDED CONTITION)

Weld mechanical properties were developed as basic weld procedure specification qualification back-up data per the requirements of MIL-STD-248, "Welding Procedure and Performance Qualifications." Through the use of standard Navy procedures for the development and establishment of welding procedure qualification tests, typical as-welded condition mechanical properties were readily attained. All butt weld test specimens were 5000 series aluminum alloy sheet and plate material manually welded out-of-position, one-side, full penetration type with the use of the pulse gas metal arc process.

Although the welding tests were conducted in the welding laboratory, all test specimens were welded under conditions as close as possible to actual production fabrication. This practical approach was encompassed because welding variables greatly reflect mechanical properties values for 5000 series aluminum alloys, and naval architects and marine engineers are primarily concerned with as-welded mechanical properties.

The non-heat treatable 5000 series aluminum alloys depend upon chemical composition and cold working or strain hardening for their mechanical properties. Welding primarily affects these alloys by annealing. When welding heat input is increased, the width of the heat-affected-zone(HAZ) is increased. Significant changes in-weld metal strength occur as heat input varies by welding techniques. It has been reported that yield strength (Psi) could vary from 35,000 psi for stringer type weld beads to 30,000 psi for tide weave type weld deposits. The mechanical properties of a weld decrease with increased total heat input.

Upon completion of welding and non-destructive testing, as described earlier in this report, the weld procedure qualification test panels (approximately 12". x 16" x $_{\rm T}$), were sawed into tensile and bend specimens. See Figure 65 which illustrates the cutting diagram of the test panel. Tensile specimens (transverse welds) and root and face bend specimens were machined per sketches in Figures 66 and 67.

	¥WELD
DISCARD	
REDUCED SECTION	TENSILE SPECIMEN
BEND	SPECIMEN
REDUCED SECTION	TENSILE SPECIMEN
DISCARD	

FIGURE 65

CUTTING DIAGRAM OF WELD TEST PANELS FOR TENSILE & BEND TEST SPECIMENS

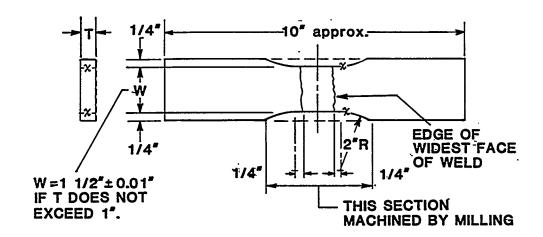
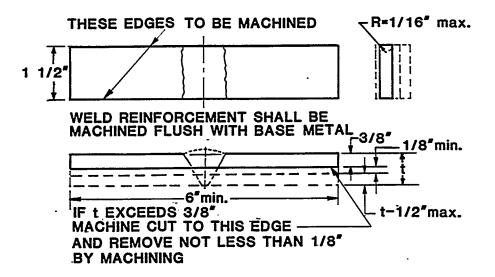
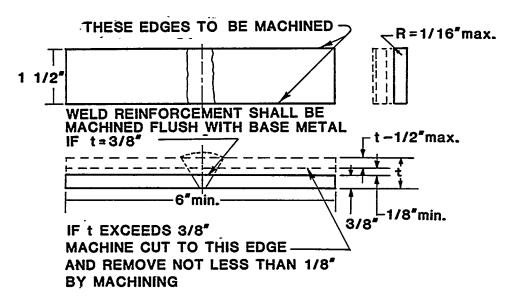


FIGURE 66
TRANSVERSE WELD TENSILE SPECIMEN CONFIGURATION



FACE BEND SPECIMEN



ROOT BEND SPECIMEN

All surface and underbead weld reinforcements were removed flush by machining. A typical set of flush-machined, transverse weld, reduced section tensile specimens and root and face bend specimens are shown in Figure 68.

For convenience, the general welding parameters for mechanical property test panels are listed according to their code identification numbers. See Figure 69. For specific detailed information, see the following section covering Machine Settings. Also, 5000 series aluminum alloy "0" temper tensile and yield strengths are specified in Figure 70.

* * * * * * *

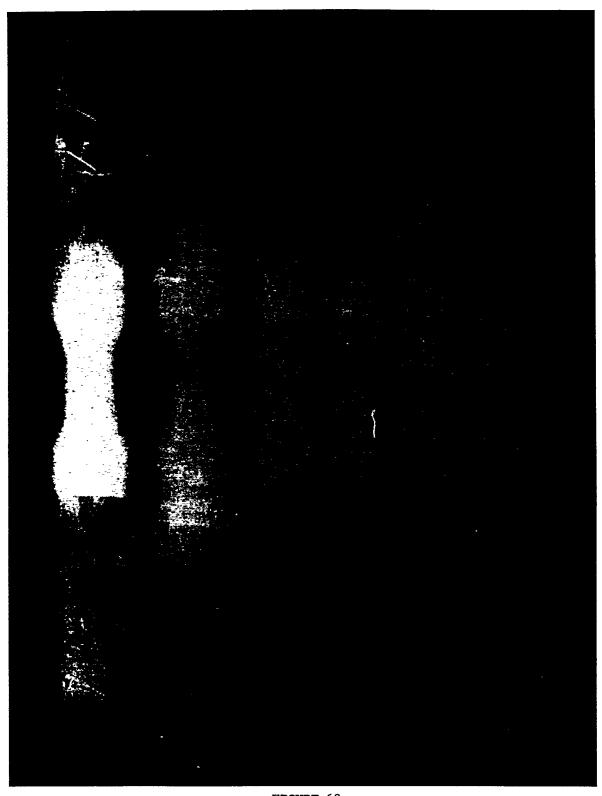


FIGURE 68
TYPICAL FLUSH MACHINED, TRANSVERSE WELD,
REDUCED SECTION TENSILE & ROOT & FACE BEND SPECIMENS
(Q.1QQ" THICK 5086 H-32; VERTICAL-UP; 5356 FILLER)

MATERIAL THICKNESS	PLATE NO.	<u>VOLT</u>	AMP.	WIRE SPEED	TRAVEL SPEED	POWER SOURCE	WIRE DIA.	FILLER ALLOY
.063"	A1.3	15	50	125	18	PA-350	3/64"	5556
.063"	A1.23	15.5	40	172	18.5	PA-350	3/64"	5356
.063"	A1.14	15	50	168	18	PA-350	3/64"	5556
.063"	A2.5	15.5	50	155	20	PA-350	3/64"	5556
.100"	B.18	19	45	300	15.6	PA-3A	.030"	5356
.100"	B.50	19	55	260	18	PA-3A	.035"	5356
.100"	B.74	16	70	205 -	17	PA-350	3/64"	5356
.125"	C.60	17	70	225	12.8	PA-350	3/64"	5356
.125"	C.63	17	70	240	14.1	PA-350	3/64"	5556
.125"	C.30	19.5	85 ,	245	15	PA-350	3/64"	5556
.125"	C.46	15	105	280	20	PA-350	3/64"	5356
.250"	D.8	16	150	362	11.5	PA-350 .	3/64"	5556
.250"	D.10	14.5	149	327	8.4	PA-350	3/64"	5556
2								
.250"	E.33	14.5	156	343	8.9	PA-350	3/64"	5556
ν								
.250"	F.3	15.7	130	330	12	PA-350	3/64"	5556
.250" 1	F.13	14.5	145	333	10.2	PA-350	3/64"	5556
·						•		
.500"	I.10	25	150	375	14	PULSTAR 450	3/64"	5356
		28	160	400	11.5			
		28	157	390	11.5			

FIGURE 69
WELDING PARAMETERS FOR MECHANICAL PROPERTIES TESTS PANELS

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				"0" Т	EMPER MECHAN	ICAL PROPERT	TIES
ALUMINUM	SHEET/PLATE	MATERIAL	TENSILE ST		YIELD ST		<u>ELONGATION</u>
ALLOY	THICKNESS	SPECIFICATION	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	(IN 2 INCHES)
5086 н-32	.063"; .10"	QQ-A-250/7	35,000	44,000	14,000		18
5086 Н-116	1/4"; 1/2"	QQ-A-250/19	35,000	44,000	14,000		16
	_, _, _,_	44	00,000	, 5 5 5	21,,000		10
5083 н-323	1/8"	QQ-A-250/6	40,000	51,000	18,000	29,000	16
J005 II-323	1/0	QQ-A-250/0	40,000	51,000	18,000	29,000	10
5083 н-321	1/4"						
5083 н-321	1/2"						
3003 11 321	1,2						
5456 H-116	1/4"; 1/2"	00.4.250/20	42 000	52 000	10 000		16
3436 H-116	1/4 ; 1/2"	QQ-A-250/20	42,000	53,000	19,000		16

FIGURE 70

5000 SERIES ALUMINUM ALLOY
"O" TEMPER MECHANICAL PROPERTIES

NORTHWEST LABORATORIES' REPORTS

All testing of weld mechanical properties specimens were conducted at Northwest Laboratories in Seattle, Washington, an independent testing laboratory. AIS of the aluminum alloy test specimens were tested on a Tinius Olson Super "L" Universal Testing Machine calibrated one step removed from the National Bureau of Standards. This machine was calibrated on April 8, 1983 by Pacific Scientific Company.

The following pages cover specific and pertinmt detailed Northwest Laboratories' reports covering out-of-position, one-side, full penetration manual pulse gas metal arc butt welding of 5000 series aluminum alloy sheet and plate. A summary of the mechanical properties data, and photographs of the mechanical properties specimens after destructive testing are shown in Figures 71, 72, and 73.

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1530 FIRST AVENUE SOUTH

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Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Corp.

Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431

Lab No: E 28426-2

IDENTIFICATION:

Test No. Al.3 Vertical Up Base Material & Temper 5086-H32 QQ-A-250/7 Material Thickness - 0.063" Filler Metal- 5556 Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	TI	T2	Specified
Measurements	0.055 x 1.506	0.057 x 1.507	
Area Sq. Inches	0.0828	0.0859	
Yield Strength, Lbs. Actual	1,960	1,980	Info only
Yield Strength, PSI	23,670	23,050	
Ultimate Load, Lbs.	2,980	3,080	35,000 min.
Tensile Strength, PSI	35,990	35,860	
Elongation in 2 inches Elongation, %	0.14 7.0	0.17 8.5	Info only
Fracture Location	HAZ	HAZ	

BEND TESTS

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	No defects, Satisfactory
3	Root	No defects, Satisfactory
4	Root	No defects, Satisfactory

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Report To: Todd Pacific Shipyards Corp.

Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431

Lab No: E 28426-3

IDENTIFICATION:

Test No. Al.23 Vertical Up
Base Material & Temper 5086-H32 QQ-A-250/7
Material Thickness - 0.063"
Filler Metal - 5356
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	TI	T2	Specified
Measurements	0.053 x 1.510	0.051 x 1.510	
Area Sq. Inches	0.0800	0.0770	
Yield Strength, Lbs. Actual	1,820	1,800	Info only
Yield Strength, PSI	22,750	23,380	
Ultimate Load, Lbs.	2,940	2,880	35,000 min.
Tensile Strength, PSI	36,750	37,400	
Elongation in 2 inches Elongation, %	0.18 9.0	0.17 8.5	Info only
Fracture Location	Thru weld	Thru weld	

BEND TESTS

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	No defects, Satisfactory
3	Root	No defects, Satisfactory
4	Root	No defects, Satisfactory

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Report To: Todd Pacific Shipyards Corp. Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431 Lab No: E 28426-1

IDENTIFICATION:

Test No. Al.14 Horizontal
Base Material & Temper 5086-H32 QQ-A-250/7
material Thickness - 0.063"
Filler Metal- 5556
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	T2	Specified
Measurements	0.048 X 1.508	0.052 X 1.507	
Area Sq. Inches	0.0724	0.0784	
Yield Strength, Lbs. Actual	1,810	1,800	Info only
Yield Strength, PSI	25,000	22,960	
Ultimate Load, Lbs.	2,680	2,760	35,000 min.
Tensile Strength, PSI	37,020	35,200	
Elongation in 2 inches Elongation, %	0.14 7.0	0.17 8.5	Info only
Fracture Location	H A Z	HAZ	

BEND TESTS

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	No defects, Satisfactory
	3 Root	1 crack 3/64", Satisfactory
4	Root	No defects, Satisfactory

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Report To: Todd Pacific Shipyards Corp.

Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431

Lab No: E 28426-4

IDENTIFICATION:

Test No. A2.5 Overhead
Base Material & Temper 5086-H32 QQ-A-250/7
Material Thickness - 0.063"
Filler Metal- 5556
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	T2	Specified
Measurements	0.052 X 1.506	0.052 X 1.507	
Area Sq. Inches	0.0783	0.0784	
Yield Strength, Lbs. Actual	1,830	1,830	Info only
Yield Strength, PSI	23,370	23,340	
Ultimate Load, Lbs.	2,780	2,920	35,000 min.
Tensile Strength, PSI	35,500	37,240	
Elongation in 2 inches Elongation, %	0.16 8.0	0.17 8.5	Info only
Fracture Location	HAZ	HAZ	

BEND TESTS

Number	Type of Bend	Results
1	Face Face	No defects, Satisfactory No defects, Satisfactory
4	Root Root	No defects, Satisfactory No defects, Satisfactory

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Report To: Todd Pacific Shipyards Corp.

Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431

Lab No: E 28426-5

IDENTIFICATION:

Test No. B1 .18 Vertical Up
Base Material & Temper 5086-H32 QQ-A-250/7
material Thickness - 0.100
Filler Metal- 5356
Test Procedure - Mil-Std-248C

TEST RESULTS :

Bar Number	T1	T2	Specified
Measurements	0.089 X 1.509	0.091 X 1.509	
Area Sq. Inches	0.134	0.137	
Yield Strength, Lbs. Actual	2,700	2,960	Info only
Yield Strength, PSI	20,150	21,610	
Ultimate Load, Lbs.	4,700	4,940	35,000 min.
Tensile Strength, PSI	35,070	36,060	
Elongation in 2 inches Elongation, %	0.16 8.0	0.16 8.0	Info only
Fracture Location	Thru Weld.	Thru Meld	

BEND TESTS

Number	Type of Bend	Results
2 3 4	1 Face Face Root Root	No defects, Satisfactory No defects, Satisfactory No defects, Satisfactory No defects, Satisfactory

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Report To: Todd Pacific Shipyards Corp. Date: June 24, 1983

Report On: Aluminum Welds, PO PS 81431 Lab No: E 28426-6

IDENTIFICATION:

Test No. B50 Horizontal
Base Material and Temper - 5086 H-32 QQ-A-250/7
Material Thickness - 0.100"
Filler Metal - 5356
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	Т2	Specified
Measurements Area Sq. Inches	0.092 x 1.511	0.090 x 1.511 0.136	
Yield Strength, Lbs. Actual Yield Strength, PSI	2,900 20,860	2,840 20,880	Info only
Ultimate Load, Lbs. Tensile Strength, PSI	4,910 35,320	4,870 35,810	35,000 min.
elongation in 2 Inches Elongation, %	0.16 8.0	0.16 8.0	Info only
Fracture Location	Thru Weld	Thru Weld	

BEND TESTS:

Number	Type of Bend	Results
1	Face	No defects, Satisfactor
	2 Face	No defects, Satisfactor
1	Root	No defects, Satisfactor
2	Root	No defects, Satisfactor

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Report To: Todd Pacific Shipyards Corp. Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431 Lab No: E 28426-7

IDENTIFICATION:

Test No. B74 Overhead
Base Material & Temper 5086-H32 QQ-A-250/7
Material Thickness - 0.100"
Filler Metal- 5356
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	T2	Specified
Measurements Area Sq. Inches	0.088 X 1.511 0.133	0.089 X 1.510 0.135	
Yield Strength, Lbs. Actual Yield Strength, PSI .	3,040 22,860	3,170 23,480	Info only
Ultimate Load, Lbs. Tensile Strength, PSI	4,860 36,540	5,060 37,480	35,000 min.
Elongation in 2 inches Elongation, %	0.18 9.0	0.18 9.0	Info only
Fracture Location	Thru weld	Thru weld	

BEND TESTS

Number	Type of Bend	Results	
	Face	No defects, Satisfactory	
2	Face	No defects, Satisfactory	
	Root	No defects, Satisfactory	
4	Root	No defects, Satisfactory	

205

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Report To: Todd Pacific Shipyards Date: June 28, 1983

Report On: Aluminum Welds, PO PS 81431 Lab No: E 28426-10

IDENTIFICATION:

Test No. C60 Vertical Up
Base Material & Temper - 5083-H323 QQ-A-250/6
Material Thickness - 0.125"
Filler Metal - 5556
Test Procedure Mil-Std-248C

TEST RESULTS:

Bar Number	T1	Т2	Base Metal Actual Tests
Measurements	0.113 x 1*510	0.113 x 1.511	
Area Sq. Inches	0.171	0.171	
Yield Strength, Lbs. Actual	3,710	3,800	26,430
Yield Strength, PSI	21,700	22,220	
Ultimate Load, Lbs.	6,520	6,410	41,460
Tensile Strength, PSI	38,130	37,480	
Elongation in 2 Inches Elongation, %	0.24 12.0	0.24 12.0	19.5
Fracture Location	Thru Weld	Thru HAZ	

BEND TESTS

Number	Type of Bend	Results	
	Face		Satisfactory
2	Face	No defects,	Satisfactory
	Root	No defects,	Satisfactory
2	Root	No defects,	Satisfactory

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Report To: Todd Pacific Shipyards Date: June 28, 1983

Report On: Aluminum Welds, PO PS 81431 Lab No: E 28426-11

IDENTIFICATION:

Test No. C63 Vertical Up
Base Material & TemUer - 5083 -H323 QQ-A-250/6
Material Thickness - 0.125"
Filler Metal - 5356
Test Procedure Mil-Std-248C

TEST RESULTS:

Bar Number	T1	Т2	Base Metal Actual Tests
Measurements	0.113 X 1.510	0.110 X 1.512	
Area Sq. Inches	0.171	0.166	
Yield Strength, Lbs. Actual	4,040	3,680	26,430
Yield Strength, PSI	23,630	22,170	
Ultimate Load, Lbs.	6,400	6,300	41,460
Tensile Strength, PSI	37,430	37,950	
Elongation in 2 Inches Elongation, %	0.23 11.5	0.20 10.0	19.5
Fracture Location	Thru Weld	Thru Weld	

BEND TESTS

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	No defects, Satisfactory
	Root	No defects, Satisfactory
2	Root	No defects, Satisfactory

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Report To: Todd Pacific Shipyards Date: June 28, 1983

Report On: Aluminum Welds, PO PS 81431 Lab No: E 28426-8

IDENTIFICATION:

Test No. C30 Horizontal
Base Material & Temper- 5083-H323 QQ-A-250/6
Material Thickness - 0.125"
Filler Metal - 5556
Test Procedure Mil-Std-248C

TEST RESULTS:

Bar Number	T1	Т2	Base Metal Actual Tests
Measurements	0.115 x1.507	0.116 X 1.507	
Area Sq. Inches	0.173	0.175	
Yield Strength, Lbs. Actual	3,810	3,615	26,430
Yield Strength, PSI	22,020	20,660	
Ultimate Load, Lbs.	6,400	6,360	41,460
Tensile Strength, PSI	36,990	36,340	
Elongation in 2 Inches Elongation, %	0.24 1 2 . 0	0.24 12.0	19.5
Fracture Location	Thru Weld	Thru Weld	

BEND TESTS

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	No defects, Satisfactory
1	Root	No defects, Satisfactory
2	Root	No defects, Satisfactory

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Report To: Todd Pacific Shipyards Date: June 28, 1983

Report On: Aluminum Welds, PO PS 81431 Lab No: E 28426-9

IDENTIFICATION:

Test No. C46 Overhead
Base Material & Temper - 5083 -H323 QQ-A-250/6
Material Thickness - 0.125"
Filler Metal - 5356
Test Procedure Mi1-Std-248C

TEST RESULTS :

Bar Number	T1	Т2	Base Metal Actual Tests
Measurements	0.117 x 1.512	0.107 x 1.510	
Area Sq. Inches	0.177	0.162	
Yield Strength, Lbs. Actual	3,940	3,640	26,430
Yield Strength, PSI	22,260	22,470	
Ultimate Load, Lbs.	6,650	6,160	41,460
Tensile Strength, PSI	37,570	38,020	
Elongation in 2 Inches Elongation, %	0.24 12.0	0.20 10.0	19.5
Fracture Location	Thru Weld	Thru Weld	

BEND TESTS

Number	Type of Bend	Results
	Face	No defects, Satisfactory
1	Face	No defects, Satisfactory
1	Root	No defects, Satisfactory
2	Root	No defects, Satisfactory

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1530 FIRST AVENUE SOUTH 1 SEATTLE, WASHINGTON 98134 1 Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Corp. Date: June 20, 1983

Report On: Aluminum, PO PS 81458 Lab No: E 28495-2

IDENTIFICATION:

0.125" thick 5083 -H323 Aluminum Alloy QQ-A-250/6F

TEST RESULTS:

Bar Number	T1	T2	Specified
Measurements	0.127 x 1.507	0.128 x 1.510	
Area Sq. Inches	0.191	0.193	
Yield Strength, Lbs. Actual	5,050	5,100	34,000-44,000
Yield Strength, PSI	26,440	26,420	
Ultimate Load, Lbs.	7,960	7,960	45,000-54,000
Tensile Strength, PSI	41,680	41,240	
Elongation in 2 Inches Elongation, %	0.39 19.5	0.39 19.5	8 min.

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1530 FIRST AVENUE SOUTH 1 SEATTLE, WASHINGTON 98134 1 Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Corp. Date: June 17, 1983

Report On: Aluminum Welds, PO PS81431 Lab No: E 28426-12

IDENTIFICATION:

Test No. D8 Vertical Up
Base Material & Temper 5086-H116 QQ-A-250/1 9
Material Thickness - 0.250"
Filler Metal- 5556
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	T2	Specified
Measurements	0.228 X 1.505	0.240 X 1.505	
Area Sq. Inches	0.343	0.361	
Yield Strength, Lbs. Actual	7,250	7,300	Info only
Yield Strength, PSI	21,140	20,220	
Ultimate Load, Lbs.	12,400	13,600	35,000 min.
Tensile Strength, PSI	36,150	37,670	
Elongation in 2 inches Elongation, %	0.16 8.0	0.21 10.5	Info only
Fracture Location	Thru Weld	Thru Weld	

BEND TESTS

Number	Type of Bend	Results
2	Face Face	4 cracks 1/32", Satisfactory No defects, Satisfactory
4	Root Root	No defects, Satisfactory No defects, Satisfactory

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Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH 1 SEATTLE, WASHINGTON 98134 Telephone: (206) 622-068

Report To: Todd Pacific Shipyards Date: July 7, 1983

Report On: Aluminum Welds, PO PS 8145B Lab No: E 28635-3

IDENTIFICATION:

Test No. D-10 Horizontal

Base Material & Temper - 5086 - H116 QQ-A-250/19

Material Thickness - 0.250"

Filler Metal- 5556

Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	Т2	Specified
Measurements	0.236 X 1.510	0.237 X 1.509	
Area Sq. Inches	0.356	0.358	
Yield Strength, Lbs. Actual	7,000	6,700	Info only
Yield Strength, PSI	19,660	18,710	
Ultimate Load, Lbs.	14,150	14,200	35,000 min.
Tensile Strength, PSI	39,750	39,660	
Elongation in 2 Inches Elongation, %	0.26 13.0	0.29 14.5	Info only

Fracture Location Thru Weld Thru Weld

B END TESTS:

Number	Type of Bend	Results
	Face	No defects, Satisfactory
1	Face	No defects, Satisfactory
	Root	No defects, Satisfactory
2	Root	No defects, Satisfactory

NORTHWEST LABORATORIES

ALBERT O. WAHTO, PE Chief Testing Engineer License No. 3004

of Seattle, Incorporated ESTABLISHED 1896

Technical Services for: Industry, Commerce. Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH 1 SEAITLE, WASHINGTON 98134 1 Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Date: July 7, 1983

Report On: Aluminum welds, PO PS 8145B Lab No: E 28635-2

IDENTIFICATION:

Test No. E-33 Horizontal

Base Material & Temper - 5456 - Hll6 QQ-A-250/7

Material Thickness - 0.250"

Filler Metal- 5556

Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	Tl	Т2	Specified
Measurements Area Sq. Inches	0.245 <i>X</i> 1.506 0.369	0.246 X 1.506 0.369	
Yield Strength, Lbs. Actual Yield Strength, PSI	8,700 23,580	9,250 25,070	Info only
Ultimate Load, Lbs. Tensile Strength, PSI	15,600 42,280	15,800 42,820	42,000 min.
elongation in 2 Inches Elongation, %	0.19 9.5	0.20 10.0	Info only

Fracture Location Thru Weld Thru Weld

BEND TESTS:

Number	Type of Bend	Results
	Face	No defects, Satisfactory
1	Face	No defects, Satisfactory
1	Root	No defects, Satisfactory
2	Root	No defects, Satisfactory

NORTHWEST LABORATORIES

ALBERT O. WAHTO, PE Chief Testing Engineer License No. 3004

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Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH SEATTLE, WASHINGTON 98134 Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Corp. Date: June 24, 1983

Report On: Aluminum Welds, PO PS 81431 Lab No: E 28426-14

IDENTIFICATION:

Test No. F3 - Vertical Up
Base Material and Temper- 5083-H321 QQ-A-250/6
Material Thickness - 0.250"
Filler Metal - 5556
Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	TI	T2	Specified
Measurements Area Sq. Inches	0.230 X 1.503 0.346	0.236 X 1.512 0.356	
Yield Strength, Lbs. Actual Yield Strength, PSI	7,260 20,980	7,930 22,280	Info only
Ultimate Load, Lbs. Tensile Strength, PSI	14,000 40,460	15,150 42,560	40,000 min.
elongation in 2 Inches Elongation, %	0.17 8.5	0.21 10.5	Info only
	mb wald	mboo. Wald	

Fracture Location Thru Weld Thru Weld

BEND TESTS:

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	1 crack 1/16", Satisfactory
1	Root	1 crack 3/32", Satisfactory
2	Root	No defects, Satisfactory

NORTHWEST LABORATORY ES

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of Seattle, Incorporated ESTABLISHED 1896

Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH 1 SEATTLE, WASHINGTON 98134 1 Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Date: July 7, 1983

Report On: Aluminum Wel ds, PO PS 8145B Lab No: E 28635-1

IDENTIFICATION:

Test No. F-13 Horizontal

Base Material & Temper - 5083 - H321 QQ-A-250/6

Material Thickness - 0.250"

Filler Metal- 5556

Test Procedure - Mil-Std-248C

TEST RESULTS:

Bar Number	T1	T2	Specified
Measurements	0.243 X 1.508	0.234 X 1.508	
Area Sq. Inches	0.366	0.353	
Yield Strength, Lbs. Actual	7,420	8,300	Info only
Yield Strength, PSI	20,270	23,510	
Ultimate Load, Lbs.	15,350	14,850	40,000 min.
Tensile Strength, PSI	41,940	42,070	
Elongation in 2 Inches Elongation, %	0.26 13.0	0.23 11.5	Info only

Fracture Location Thru Weld Thru Weld

BEND TESTS:

Number	Type of Bend	Results
1	Face	No defects, Satisfactory
2	Face	No defects, Satisfactory
1	Root	No defects, Satisfactory
2	Root	No defects, Satisfactory

NORTHWEST LABORATORIES

ALBERT O. WAHTO, PE Chief Testing Engineer License No. 3004

of Seattle, Incorporated ESTABLISHED 1896

Technical Services for: Industry, Commerce, Legal Profession & Insurance industry

1530 FIRST AVENUE SOUTH 1 SEATTLE, WASHINGTON 98134 1 Telephone: (206) 622-0680

Report To: Todd Pacific Shipyards Date: November 1, 1983

Report On: Welds PO PS 81723 Lab No: E 29361

IDENTIFICATION:

Set No. 1-10

Base material 5083-H321 for QQ-A-250/6 1/2" thick plate Filler Material - 5356 position- flat Mechanized Tested per Mil-Std-248C

TEST RESULTS :

	Tensile :	<u> Test</u>	S~ecified
Bar #	T1	Т2	s~ecilled
Measurements Area Sq. Inches	1.497 <i>X</i> .467 .699	1.497 x .474 .710	
Yield Strength, Lbs. Actual Yield Strength, PSI	14,250 20,390	14,340 20,200	Info. Only
Ultimate Load, Lbs. Tensile Strength, PSI	28,550 40,840	28,470 40,100	40,000 Min.
Elongation In 2 Inches Elongation, %	.29 14.5	.22 11.0	Info. Only
Fracture Location	Thru weld	Thru weld	

Bend Tests

No.	Type of Bend	Results
F1	Face	3 cracks 1/64" Satisfactory
F2	Face	Cracks 1/64" to 1/32" Satisfactory
R1	Root	No Defects Satisfactory
R2	Root	No Defects Satisfactory

NORTHWEST LABORATORIES

ALBERT O. WAHTO, PE Chief Testing Engineer

of Seattle, Incorporated
ESTABLISHED 1896

Technical Services for: Industry, Commerce, Legal Profession & Insurance Industry

1530 FIRST AVENUE SOUTH

SEATTLE, WASHINGTON 98134

Telephone: (206, 622-0680

WELDING

August 25, 1983

Todd Shipbuilding & Construction Co. P.O. Box 3806
Seattle, WA 98124
Attn: Mike Nakata

Dear Sir:

This is to certify that the aluminum weld test coupons were tested on our Tinius Olson Super "L" Universal Testing Machine calibrated one step removed from the National Bureau of Standards. Calibrated on April 8, 1983 by Pacific Scientific Company.

ALBERT O. WAHTO, PE Chief Testing Engineer

License No. 3004

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	TYPICAL	TEST NUMBER & Weld Position	BASE MATERIAL	TEMPER	BASE MATERIAL THICKNESS	FEDERAL SPECIFICATION	X-RAY RESULTS	PENETRANT RESULTS	FACE BEND	ROOT BEND	TENSILE 1 PSI	TENSILE 2 PSI	SPECIFIED * TENSILE	COMMENTS
_	A1.14	HORIZONTAL	5086	н-32	.063"	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	37,020	35,200	35,000	ACCEPTAB
-	A1.3	VERTICAL-UP	5086	н-32	.063"	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	35,990	35,860	35,000	ACCEPTAB
-	A1.23	VERTICAL-UP	5086	н-32	.063"	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	36,750	37,400	35,000	ACCEPTAB
-	A2.5	OVERHEAD	5086	H-32	.063"	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	35,500	37,240	35,000	ACCEPTAB
-	B1.18	VERTICAL-UP	5086	н-32	.100"	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	35,070	36,060	35,000	ACCEPTAB
-	в.74	OVERHEAD	5086	H-32	.100"	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	36,540	37,480	35,000	ACCEPTAB
-	в.50	HORIZONTAL	5086	H-32	,100 ^{tt}	QQ-A-250/7	ACCEPT	ACCEPT	ACCEPT	ACCEPT	35,320	35,810	35,000	ACCEPTAB
-	C.30	HORIZONTAL	5083	H-323	.125"	QQ-A-250/6	ACCEPT	ACCEPT	ACCEPT	ACCEPT	34,990	36,340	40,000	
-	C.46	OVERHEAD	5083	н-323	.125"	QQ-A-250/6	ACCEPT	ACCEPT	ACCEPT	ACCEPT	37,570	38,020	40,000	
-	C.60,	VERTICAL-UP	5083	н-323	.125"	QQ-A-250/6	ACCEPT	ACCEPT	ACCEPT	ACCEPT	38,130	37,480	40,000	
-	C.63	VERTICAL-UP	5083	H-323	.125"	QQ-A-250/6	ACCEPT	ACCEPT	ACCEPT	ACCEPT	37,430	37,950	40,000	i>
-	D.8	VERTICAL-UP	5086	н-116	.250"	QQ-A-250/19	ACCEPT	ACCEPT	ACCEPT	ACCEPT	36,150	37,670	35,000	ACCEPTAB
-	F.3	VERTICAL-UP	5083	H-321	.250"	QQ-A-250/6	ACCEPT	ACCEPT	ACCEPT	ACCEPT	40,460	42,560	40,000	ACCEPTAB
-	F.13	HORIZONTAL	5083	H-321	. 250"	QQ-A-250/6	ACCEPT	ACCEPT	ACCEPT	ACCEPT	41,940	42,070	40,000	ACCEPTAB
-	E.33	HORIZONTAL	5456	н-116	.250"	<u> </u>	ACCEPT	ACCEPT	ACCEPT	ACCEPT	42,280	42,820	42,000	ACCEPTAB
-	D.10	HORIZONTAL	5086	н-116	.250"	QQ-A-250/19	ACCEPT	ACCEPT	ACCEPT	ACCEPT	39,750	39,660	35,000	ACCEPTAB
-														

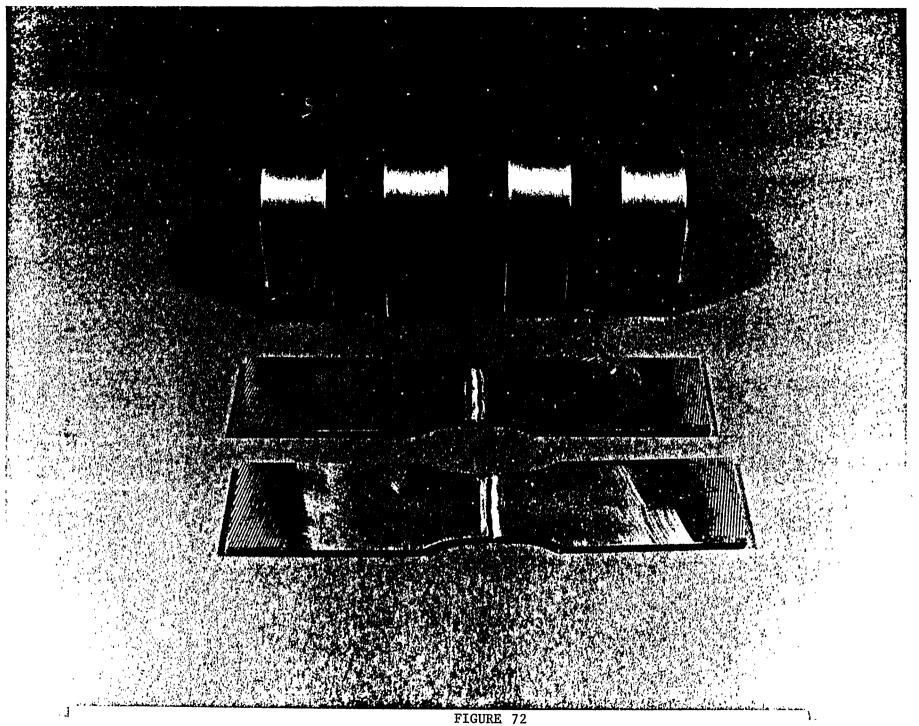
Cale. Troe	REVISEO	 ALUMINUM WELDING, ONE-SIDE, OUT-OF- POSITION, FULL PENETRATION, MANUAL GAS
CM	 	METAL ARC BUTT WELDING OF 5000 SERIES
Appr.		ALUMINUM ALLOY SHEET & PLATE
Appr.		TODD PACIFIC SHIPYARD CORP., SEATTLE

FIGURE 71
MECHANICAL PROPERTIES DATA
* "O" TEMPER

DATA SHEET



LOW BASE METAL TENSILE STRENGTH: 0.125" THICK 5083-H323
YIELD STRENGTH 26,430 PSI ACTUAL INSTEAD OF 34,000-44,000PSI
TENSILE STRENGTH 41,460 PSI ACTUAL INSTEAD OF 45,000-54,000 P



TYPICAL MECHANICAL PROPERTIES TEST SPECIMENS AFTER TENSILE AND BEND TESTS



PULSE ARC WELDING MACHINE SETTINGS

Pulse arc welding machine settings that were determined and established during this program are shown in a summary page form and also in individual machine setting forms. These machine settings represent actual values developed during the course of this investigation and apply primarily to butt welding in the out-of-position, one-side, full penetration manual gas metal arc welding of 5000 series aluminum alloy sheet and plates. These values provide excellent starting weld parameters and should be adjusted accordingly for other weld joint designs and other marine aluminum alloys.

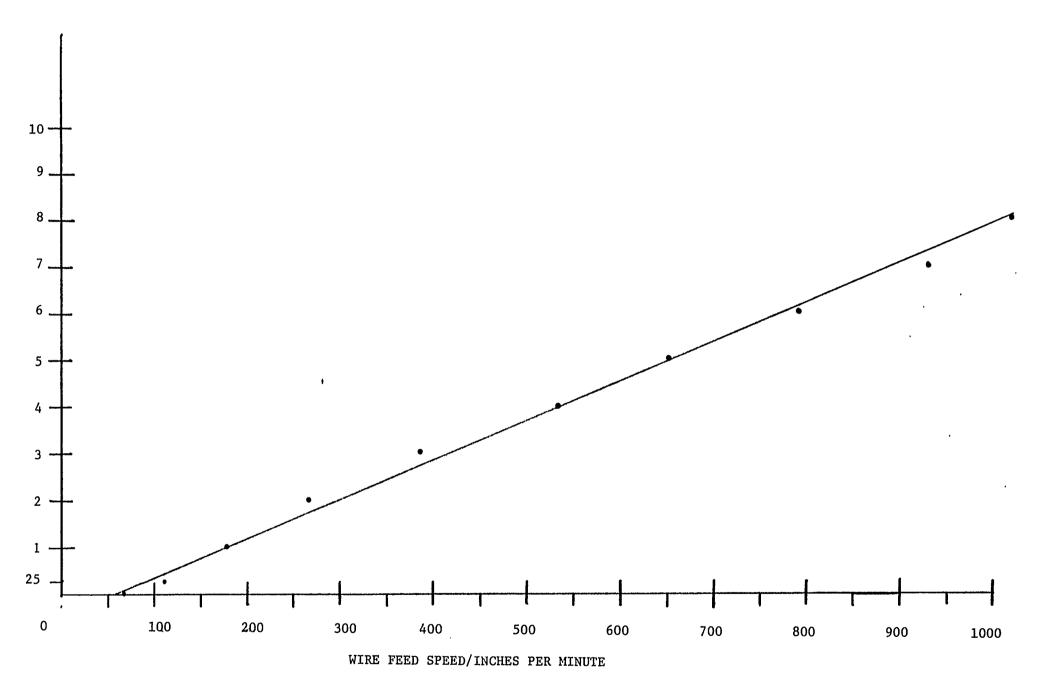
Charts showing wire feed speeds (inches per minute) vs. wire speed dial settings have been developed for the Airco System 1, Airco AHF-NP, Gilliland MTG 4001 and the M & K wire feeders. It is anticipated that these charts would be helpful in the developmental determination of individual machine settings.

The following information covering pulse arc welding machine settings are divided into three sections: Airco PA-3A & PA-350, Gilliland CV-600 FI-PA, and the Miller Pulstar 450. Each section includes a matrix of machine settings, wire feed speeds vs. dial settings and individually developed detailed weld machine settings.

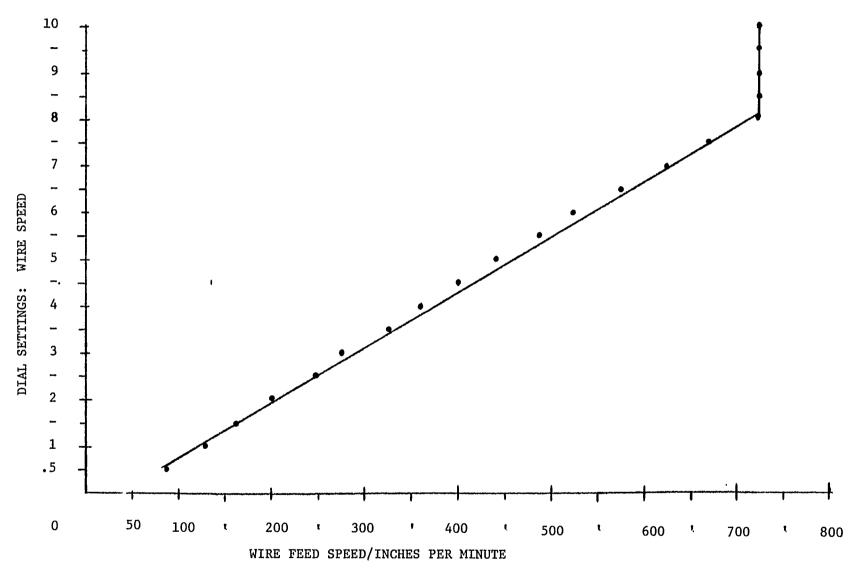
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WELDING POSITION

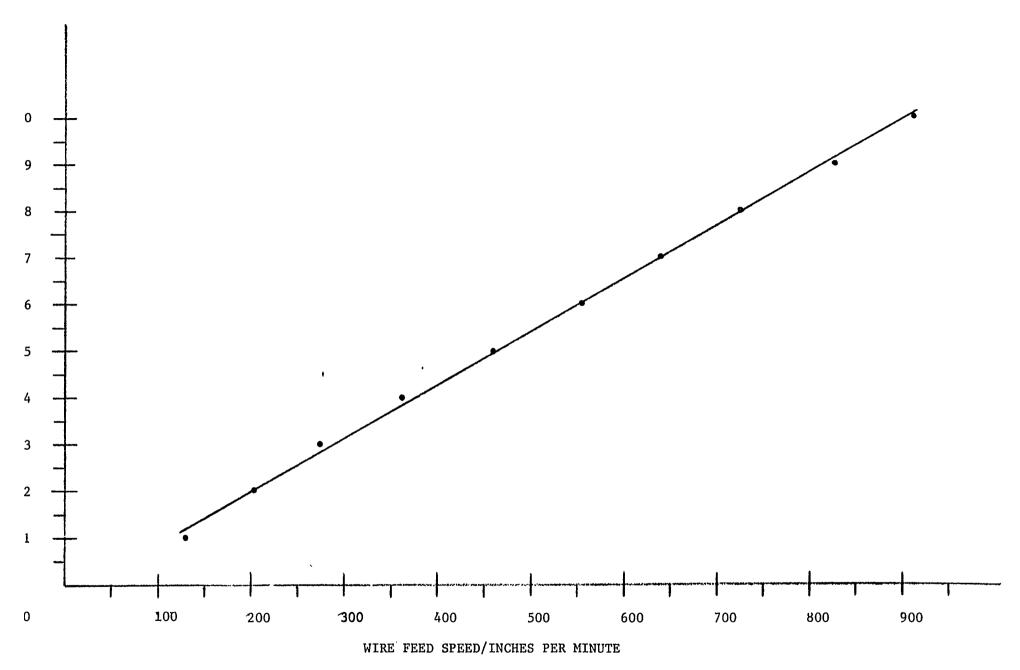
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A	.063"		xx	xx			,									ХХ		5356
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В	.100" 5086	xx	xx				XX				•	ХХ				ХХ		5356
	н–32		xx															5556
С	.125" 5083		xx	xx			·					хх				хх		5356
	н-323		xx	ХХ			XX	ХХ								хх		5556
D	.250" 5086											хх				хх		5356
	H-116			хх				XX.								хх		5556
⊳ E	.250" 5456											ХХ				XX		5356
L ALLO	н-116			XX				ХХ										5556
ATERIA "	.250" 5083											хх				хх		5356
BASE MATERIAL ALLOY	H-321			хх				xx								хх		5556
	.500" 5086			xx				хх				ХХ				ХХ		5356
	H-116								-			xx						5556
н	.500" 5456			xx				ХХ				хх				хх		5356
	H-116																	5556
I	.500" 5083			XX				XX				хх				ХХ		5356
	H-321																·	5556
		030	.035	<u>3</u>	$\frac{1}{16}$	030	.035	<u>3</u>	$\frac{1}{16}$	030	.035	<u>3</u>	<u>:1</u> 16	030	. 0 35	<u>3</u> 64	1 16	



WIRE FEED SPEED VS. DIAL SETTINGS
3/64" DIAMETER 5356 ALUMINUM ALLOY FILLER WIRE
AIRCO AHF-NP FEEDER; AH 35-C2/GUN



WIRE FEED SPEED VS. DIAL SETTINGS 3/64" DIAMETER 5556 ALUMINUM ALLOY FILLER WIRE AIRCO SYSTEM 1 FEEDER; AIRCOMATIC GUN: MANUAL MODE



WIRE FEED SPEED VS. DIAL SETTINGS
.035" DIAMETER 5356 ALUMINUM ALLOY FILLER WIRE
AIRCO SYSTEM 1 FEEDER; AIRCOMATIC GUN: MANUAL MODE

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A	.063" 5086 H-32	·		xx			•											5356
	n-32			хх				хх	,			xx	٠.					5556
В	.100" 5086	xx*					xx*					хх						5356
-	н-32																	5556
С	.125" 5083			хх								хх						5356
	н-323			xx				XX										5556
D	.250" 5086											xx				xx		5356
	н-116	· ·		ХХ				XX										5556
≽ E	.250" 5456											хх				хх		5356
BASE MATERIAL ALLOY	H-116			XX				ХХ										5556
ATERIA "	.250" 5083											ХХ				ХХ		5356
BASE M	н-321			хх				ХХ										5556
G	.500 " 5086			ХХ				xx				ХХ				хх		5356
	н-116								-			ХХ						5556
Н	.500 '' 5456			xx				xx				ХХ				хх		5356
	н-116																	5556
I	.500" 5083			хх				XX				XX						5356
	H-321																·	5556
		030	.035	<u>3</u>	1 16	030	.035	<u>3</u>	1 16	030	.035	<u>3</u> 64	<u>1</u>	030	.035	<u>3</u>	$\frac{1}{16}$,

j	BASE	- 1	1	WIRE TYPE	&								
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ļ	WIRE					1	POTENTIOM	ETER					
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•	EED-IPM				_				•		i		
31	EED-LIN		18				•				1		
Al. VE	.3 RTICAL-UP												

AIRCO PA-350 MACHINE SETTING

	BASE	WIRE TYP					
	ATERIAL	DIAMETE				LECTOR	
	3" THICKNES			PULSE	CO	ORT ARC	
	36 H-32	3/64" DIAMET	TER .	1	202	X X	2
ALI	MINUM ALLOY	<u></u>			 		
ł							
	SHIEL	D GAS ·		FLOW RA	TE		
7:	5%HE/25%AR >		4	O CFH			
		PUSHBUTTON SE	LECTOR SW	ITCHES			
		1 2 OUT IN	3 . IN	4 OUT			
	LDING		BACKG				
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	LTAGE	15.5	SETTI	NG			
WE	LDING						
	RRENT						
A	MPS	40					
1 1	CURRENT			WIRE		AUTO	1
범범	SETTING	2.25		FEED PRO	CESS		X
REMOTE PENDANT	VOLTAGE	4.43	***	<u> </u>		PLANUAL	
图图	TRIM						
"	SETTING	•5				•	
 			**	DOTESTO	Contract.		
CDI	WIRE EED-IPM		•	POTENTION SETTING	TTTK		
32	COU-LEN	172	·	DELLING	1.5		
	TRAVEL					•	
	EED-IPM	10 /					
Al. VE	.23 RTICAL-UP	18-, 4					

AIRCO PA-350 MACHINE SETTING

MATERIAL .063" THIC 5086 H-32 ALUMINUM A		ł	DIAMETER	₹ & •		שממ	בככ כו	ET 12/01	מחיי
5086 н-32	WHITE CO.		ALUMINU		TOV	PULSE			
			DIAMET		1101	FULSE			
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	TTOI	 							X
	HIELD	GAS				FLOW R	ATE		
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AMPS		50							-
CURRE	NT					WIRE		ATTE	
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REMOTE SETTI	CF	2.75	 					MAN	JAL /
TRIM			_						
SETTI		E							
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WIRE	1					POTENTIO	METER		
SPEED-IPM		168		•		SETTING		7 /	
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TRAVEL SPEED—IPM		<u>· 18</u>				•	,		

AIRCO PA-350 MACHINE SETTING

	BASE MATERIAL			WIRE T		&		. BBUCE	99 91	ELECTOR	
.00	3" THICKNE 6 H-32	SS		ALUMI " DIAM	NUM			PULSE		ORT ARC	0,
	JMINUM ALLO	Υ								Х	
	SHIE		GAS					FLOW RA	TE		
7	5%HE/25%AR	X			-	-		40 CFH			
-			PUSHI	BUTTON	SELI	CTOR	SWI	TCHES			
										 ,-	
			1	2	J.	3	T	4			
			OUT	IN	,]	IN	3 ? -	OUT			
-											
<u> </u>		-									
1	LDING LTAGE		15.	5			KGR TIN	OUND G			
	LDING RRENT				<u>v</u>					·	
	MPS		50					·			
田具	CURRENT SETTING							WIRE FEED PRO	CESS.	AUTO	
REMOTE PENDANT	VOLTAGE	-	2.5					11111111111		MANUAL	
Ь	TRIM SETTING		5								
SPI	WIRE EED—IPM		155					POTENTIOM SETTING	ETER		
	TRAVEL		133		-					1.35	
	EED-IPM		-20-		-	·				•	
A2 OVI	.5 ERHEAD										

AIRCO PA-350 MACHINE SETTING

BASE	WIRE TYPE	ž		PUI	
MATERIAL	DIAMETER			OCES	S SELECTOR
.100" THICKNESS	I I		120		60
5086 H-32	.030" DIAMETER		77	1	
ALUMINUM ALLOY			X		
SHIELD	GAS		FLOW	RAT	E
75%HE/25%AR		4	O CFH.		
					
	SELECTOR	SWITCHE			
EXTRA			NOI	RMAL	
ON ON	-OFF				
		1			
	الله				
_					
WELDING					
VOLTAGE	10			-	
WELDING	19				•
CURRENT					
AMPS	45				
CURRENT SETTING			•		
SELLING					
VOLTAGE	BACKGROU	ND	1	PE.	ΔK
SETTING	J.10300100	43	i		
		43			64
WIRE			POTENT		ETER
SPEED-IPM	301		SETTI	1G	3.9
MD ATTER			•		
TRAVEL SPEED-IPM					•
Green-tem	15.6	· .			
B1.18					
VERTICAL-UP					
1					
1					
ł					

AIRCO PA-3A MACHINE SETTING

BASE	WIRE TYPE 8	*		PUL	
MATERIAL	DIAMETER	A T T AYZ		OCESS	SELECTOR
.100" THICKNES			120		60
5086 H-32	.035" DIAMETER		X	1	
ALUMINUM ALLOY			A		
1					
SHIEI	D GAS	 	FLOW	RATE	
75%HE/25%AR			40 ,C	ĘН	
					
	SELECTOR	SWITCHES	3		
EXT	RA LOW		NOI	RMAL	
ON O	N0FF	1			
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_ 4		1			
		·			
WELDING					
VOLTAGE	19				
1	T.7				· · · · · · · · · · · · · · · · · · ·
WELDING					•
CURRENT	55				
AMPS					·
CURRENT					
SETTING			•		
		-			
VOLTAGE	BACKGROU	ND		PEA	K
SETTING		43			68
WIRE			DOMESTI	TOM	man
SPEED-IPM			POTENT		
0111111-1111	260		SELLE	16	3.6
TRAVEL					
SPEED-IPM	18 -		•		
<u> </u>		•			
B.50					
HORIZONTAL					
	•				
1					

AIRCO PA-3A MACHINE SETTING

	BASE ATERIAL	WIRE TY DIAMET		PROC	ESS SE	LECTOR	
	O' THICKNESS			PULSE		ORT ARC	
	6 н-32	3/64" DIAME		10000	CO	IAR/C	
	MINUM ALLOY	3,0.		1	2	Х	2
					,		
	SHIELD	GAS		FLOW R	ATE		
75.	ZHE/25%AR			40 CI	H		
		PUSHBUTTON S	ELECTOR SW	ITCHES			
		1 2 OUT IN	3 ? IN 3	4 OUT			
	DING TAGE	16	BACKG SETTI	ROUND NG			
	DING RENT PS	70	· •				
	CURRENT SETTING	4.0		WIRE FEED PR		AUTO MANUAL	
REMOTE	VOLTAGE TRIM SETTING	.5					
	WIRE ED-IPM	205	•	POTENTIO SETTING	METER		
	RAVEL ED-IPM	.17				•	
B.7 OVE	74 RHEAD						

AIRCO PA-350 MACHINE SETTING

1	BASE		WIRE TYPE	&					
	MATERIAL		DIAMETER			PROC	ESS SI	ELECTOR	
	5" THICKNES		6 ALUMINUM		LOY	PULSE	SHO	ORT ARC	
4	33 H - 323		4" DIAMETE	R	1		CO2	AR/C) 2-
ALU	MINUM ALLOY	<u> </u>						X	
 	SHIE	LD GAS		Г	· · · · · · · · · · · · · · · · · · ·	FLOW R	ATE	· · · · · · · · · · · · · · · · · · ·	
7	5%HE/25%AR	ХI	 			40 CFH			-
1							·		
<u> </u>									
		PUSĻ	BUTTON SEL	ECT	OR SWI	TCHES			
					•				
	ſ	<u> </u>	2	3		4 1			
	1	OUT		IN		OUT			
		OUL	1 44	<u>~`\</u>		001			
	······								
<u> </u>					.				
WE	LDING				BACKGR	מאווט			
1	LTAGE		•	•	SETTIN				
		17							
	LDING			•					
1	rrent MPS	70							
		,,,	·			 		 	
N 24	CURRENT					WIRE		AUTO.	
AN	SETTING	4.75	;			FEED PR	ocess	MANUAL	X
REMOTE PENDANT	VOLTAGE					······································			1
PE	TRIM								
	SETTING	.75	5					•	
	WIRE					POTENTIO	METER	· · · · · · · · · · · · · · · · · · ·	
SP	EED-IPM		_		1	SETTING			
		225	<u> </u>				2.25		
'	TRAVEL							•	
SP	EED-IPM	.12.	.8	-		•			
 									
1	•								
c.									
VE:	RTICAL-UP								
1									
1									
1									
L									

	BASE	WIRE	TYPE &		
1	MATERIAL	DIA	METER		ESS SELECTOR
	25" THICKNE		MINUM ALLOY	PULSE	SHORT ARC
1	33 H-323	3/64 "DI	AMETER		CO ₂ AR/CO ₂
ALI	JMINUM ALLO	Y			X
ļ					
 	SHIEI	D GAS		FLOW R	
7.	5%HE/25%AR	X		40 CFH	
		•			
		PUSHBUTTO	SELECTOR S	WITCHES	
	r	1. 2	1 3	4	
l		OUT IN		OUT	
ļ		001 111)		
<u> </u>					
WE	LDING		BACI	KGROUND	
70	LTAGE	17	SET	ring	
WE	LDING	1/			
	RRENT				
	MPS	70			
	CURRENT			WIRE	AUTO
戶	SETTING			FEED PR	OCCC
10 ₹		4.5		PEED FR	MANUAL X
REMOTE PENDANT	VOLTAGE				
_ E	TRIM	_			·
ļ	SETTING	.5			
ł	WIRE			POTENTIO	METER.
SP	eed-ipm	240	•	SETTING	2 5
-		240			
1	TRAVEL				•
SP	EED-IPM	141		•	
	60				
C-	RTICAL-UP				
\ YE	WITCHT-OL				
1					
1					

T	BASE	WIRE TY	TPE &		-		
	MATERIAL	DIAMET				LECTOR	
	25" THICKNES			PULSE		ORT ARC	
1	33 H - 323	3/64" DIAM	ETER		CO ₂	AR/C	<u> 2</u>
ALI	JMINUM ALLOY	<u> </u>				X	
		LD GAS		FLOW R	ATE		
7	5%HE/25%ARX			40 CFH	<u> </u>		
			•				
ļ		PUSHBUITON S	SELECTOR S	WITCHES			
		1 2 OUT IN	3 , IN	4 OUT			
						* * * = = =	
WE	LDING		BACK	GROUND			
VO :	LTAGE	19.5	SETT				
- साम	LDING				 	 	
	RRENT		•				
1	MPS	85					
							Г
田田	CURRENT SETTING			WIRE		AUTO	_
A	SEIIING	5.5		FEED PR	OCESS	MANUAL:	X
REMOTE PENDANT	VOLTAGE						
HE	TRIM						
	SETTING	1.0					
ļ	WIRE			POTENTIO	METER		
SP	EED-IPM	0/5	•	SETTING	•		
 		245			2	.5	
	TRAVEL						
SP	EED-IPM	15 .					
C.:	30 RIZONTAL						

	T) A C) T)	1 1777	nn armi		1					
	BASE		RE TYPE			777	Octob	033	. T. O.T. O.	_
	ATERIAL		IAMETER				OCESS			
	" THICKNESS		LUMINUM		LOX	PULSE		O ₂	RT AR	
	3 H-323	3/64"]	DIAMETER	R	- 1		- 12	2	X X	
ALU	INUM ALLOY								^	
	SHIELD	GAS		-		FLOW	RATE			
75	ZHE/25%AR			·		40	CFH			
		DIIGHRHT	TON SELI	E CTC	OD CLIT	TCHEC				
	· · · · · · · · · · · · · · · · · · ·	LOUIDDI	TOR SELL	FOI	OK SWI	ICHES				
		1	2	3		4				
		OUT I	И.	IN	W	OUT				
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		· · ·								
	DING			1	BACKGR	CUND				
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AOI	TAGE	15			SETTIN	G				
		15			SETTIN	G				
WEL	DING	15	 		SETTIN	G				
WEL	DING RENT	105			SETTIN	G 				
WEL	DING RENT IPS				SETTIN	G 1				
WEIL CUR AM	DING RENT IPS CURRENT				SETTIN	WI	RE		AUTO	
WEIL CUR AM	DING RENT IPS				SETTIN	1		eel		T
WEIL CUR AM	DING RENT IPS CURRENT	105			SETTIN	WI		ecl	AUTO MANUA	T
WEIL CUR AM	DING RENT PS CURRENT SETTING	105			SETTIN	WI		ecl		T
WEL	DING RENT PS CURRENT SETTING VOLTAGE	105			SETTIN	WI		ecl		T >
REMOTE PENDANT & CAR	DING RENT PS CURRENT SETTING VOLTAGE TRIM SETTING	105				WI	PROCE	SS		T
REMOTE PENDANT & G A	DING RENT PS CURRENT SETTING VOLTAGE TRIM SETTING WIRE	105 4.0 0				WI FEED	PROCE	SS		T
REMOTE PENDANT & G A	DING RENT PS CURRENT SETTING VOLTAGE TRIM SETTING	105				WI	PROCE	ER		T >
REMOTE PENDANT WE BE DE	DING ERENT PS CURRENT SETTING VOLTAGE TRIM SETTING WIRE ED-IPM	105 4.0 0				WI FEED	PROCE	ER	MANUA	T
REMOTE PENDANT WE SEE	DING RENT PS CURRENT SETTING VOLTAGE TRIM SETTING WIRE	105 4.0 0				WI FEED	PROCE	ER	MANUA	IL)

T	BASE	WIRE TYP			_		
	MATERIAL	DIAMETE				LECTOR	
	250" THICKNESS 5556 ALUMINUM ALLOY PULSE SHORT CO. 2						0,
	MINUM_ALLOY	L '	<u>e</u> k		2	.	-2-
1 2000	TILITOTI ALLIOI				+	X	
		LD GAS		FLOW RA			
	5%HE/25%AR			40 CF	<u> </u>		
İ						•	
		PUSHBUTTON SE	LECTOR SW	ITCHES			
1	Г	1 2	3	4			
1	1	OUT IN	IN	OUT			
	0						
				•			
WE	LDING		BACKG	ROUND			
V 01	LTAGE	16	SETTI				
WEI	LDING	10	 				
	RRENT						
A	MPS	150				·	
	CURRENT			WIRE		AUTO	
REMOTE PENDANT	SETTING			FEED PRO	CESS		V
D K	VOLTAGE	5.5				MANUAL	
開盟	TRIM						
	SETTING	•5			•		
	WIRE	- 1.1 T		POTENTION	פערא		
SPI	EED-IPM	262		SETTING			
		362		L		••0	
	TRAVEL					•	
SPI	eed-ipm	11.5					
							
D.8							
1	TICAL-UP						
YEK	* エエクサガ ー のよ						
1		1 PASS					
1							
1							
L							

AIRCO PA-350 MACHINE SETTING

	BASE		TYPE &		DDOGEG	.c. cr	LECTOR	
	MATERIAL O' THICKNESS		ETER MINUM ALI	~ +	PULSE		RT ARC	-
	0 INICAMESS 6-H116	3/64" DI		¹⁰¹	1000	CO	AR/CC	<u> </u>
1	MINUM ALLOY	3/04 51	MILLION.	- 1		-	X	2
13110								
	SHTEL	D CAC			FLOW RAT	אין		
70	SHIEL 2712/257AD	100% HE			100 CFH			
		1 100% HE			TOO CER			
		PUSHBUTTO	N SELECTO	R SWIT	CHES			
İ	ר	1 2	1 3		4			
		OUT IN	, IN		OUT			;
	_							
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WE	LDING		F	BACKGR	OUND			
VO:	LTAGE	14.5	. S	ETTIN	G NA			
WE	LDING		·					
CU	RRENT							
A ¹	MPS	149			,			-
	CURRENT				WIRE	-	AUTO	
ME	SETTING	4.25			FEED PRO	CESS	MANUAL	X.
REMOTE PENDANT	VOLTAGE		 		<u> </u>		1 1 11 10 2 111	
と問	TRIM							
	SETTING	0					•	
Γ	WIRE			1	POTENTION	ETER		
SP	EED-IPM	327	•	1	SETTING	3	•5	
						<u>_</u> _	• • • • • • • • • • • • • • • • • • • •	
	TRAVEL						•	
SP	eed-ipm	8,4	÷		•			
	D-10							
	HORIZONTAL							
1								
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			777777	(TEXT) C	·			 1	
Į.	BASE				1	BBOCE		ECTOR	
	TERIAL DIAMETER PROCE								
	O" THICKNES:					PULSE SHORT ARC COVER CO AR/CO X ROOT			
	6 H-116	53.	DO ALUI	MINUM AL	FOX		2		
ALU	MINUM ALLOY					<u>X</u>		ROOT X	
ļ									
	रमाम?	D GAS				FLOW RATE			
75	ZHE/25ZAR	X				40 C			
	ALLEY SOMETIC	<u> </u>							
				"J" GRO	OVE				
		PUS	HBUTTC	N SELECT	OR SWI	TCHES			
	_								
ł		11	2		3	4			
		OU	r (MI . IUC		OUT			
<u> </u>									
POS	SITION	OVER	HEAD						
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WEI	DING				BACKGI				
AOI	TAGE	14	26.2	*	SETTI	NG.	0		
चारा	DING								
	RRENT								
1 -	æs	158	118						
 							10	COVER	
ا م	CURRENT					WIRE		AUTO X	
EZ	SETTING	4.5	5.0			FEED PR	OCESS	MANUAL X	
REMOTE PENDANT	VOLTAGE								
三四	TRIM								
	SETTING	0	0						
	WIRE					POTENTIO	METER		
971	EED-IPM			•		SETTING	ROOT	COVER	
	1111	290	375				4.0	OTHA	
	TRAVEL								
SPI	EED-IPM	20.7	15.3	•	-				
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AIRCO FA-350 MACHINE SETTING

i	BASE ATERIAL		WIRE TY			PROC	ESS SE	LECTOR	
	Н-116	2/6	4" DIAME			PULSE	SHO	ORT ARC	
.250	" THICKNES: TINUM ALLOY		6 ALUMIN		LOY	Х	CO ₂	AR/C	0 ₂
					····		1		
		D GAS	· · · · · · · · · · · · · · · · · · ·			FLOW R			
/5	ZHE/25ZAR	Χ .				40 CF	Н		
			"J" GR					···	
		PUS	BUTTON S	ELECT	OR SWI	ICHES			
ľ	r	7	2	3	1	4			
ļ	L	OUI				OUT			
	•	001	001						
POS	ITION	FLAT	MECHANIZ	ED					
THU	DING				BACKGR	מאוזט			
	TAGE	0, 0	06.5		SETTIN		_		
		24.8	26.5				0	0	
	DING RENT								
	PS	92	124						
									Τ
E3 E4	CURRENT SETTING					WIRE		AUTO	X
D A		3.5	5.5			FEED PE	(UCE22	MANUAL	
REMOTE PENDANT	VOLTAGE TRIM								
	SETTING	0	0						
	WIRE					POTENTIO	METER		
ľ	ED-IPM	007	21/	•		SETTING			
		234	314				0	0	
	TRAVEL								
SPE	ED-IPM	12.2	16 -		· · -	٠			
ΑÜ									
BU	G-0	C.5	C.5						
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						.75↑			≤.
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D.2	Я								

AIRCO PA-350 MACHINE SETTING

1	BASE		WIRE 1	YPE &	•						
	MATERIAL		DIAME				SS S	ELECTOR	1		
.25	O' THICKNES		56 ALUMI		LLOY	PULSE		ORT ARC			
545	66 H-116	3/	64" DIAM	ETER			CO	AR/C	:0,		
ALT	MINUM ALLOY	7					-	1 :	ΧŽ		
				<u>-</u>			- [
	SHIE	D GAS				FLOW RATE					
7.	5%HE/25%AR	X				40 ~ CFH					
		PUS	HBUTTON	SELEC	TOR SWI	TCHES					
		1 00	2 T IN	, IN	3	4 OUT					
	LDING LTAGE		18		BACKGI SETTII						
CUI	LDING RRENT MPS		115	,							
OTE	CURRENT SETTING		5.5			WIRE FEED PRO	CESS	AUTO MANUAI	X		
REMOTE PENDANT	VOLTAGE TRIM SETTING		1.0			_					
SPI	WIRE EED-IPM		.305	•		POTENTION SETTING	ŒTER	3.5			
1	TRAVEL EEDIPM	-	9.3	-							
E-7 'YEI	, RTICAL-UP	1	PASS								
											

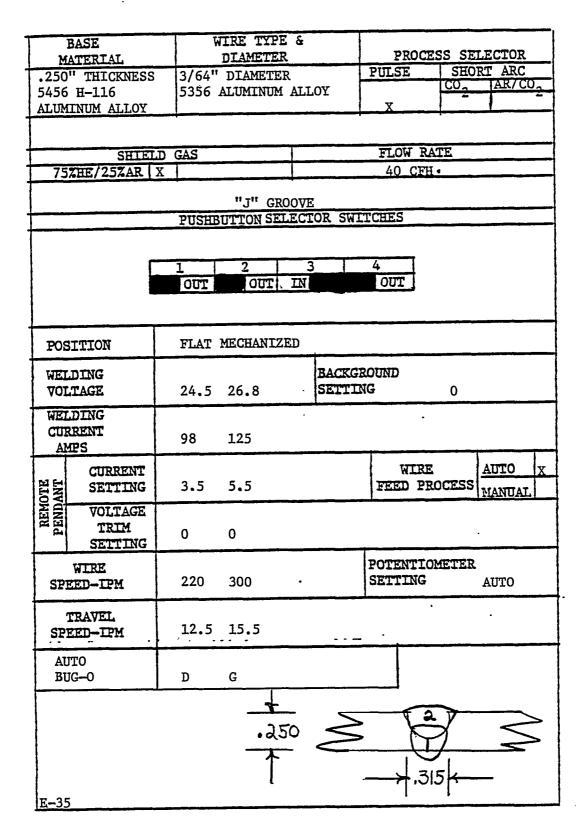
AIRCO PA-350 MACHINE SETTING

	BASE	WIRE	TYPE &							
MATERIAL		i i	DIAMETER			PROCESS SELECTOR				
.250" THICKNESS			BITHULIA		PULSE SHORT ARC					
5456-H116		5556				CO.	AR/C	5_		
	MINUM ALLOY	1	AMETER	ļ		-	X			
						- 				
		D GAS		FLOW RATE						
7	57HF/257AR	100%	HE		· 100_CFH_					
1										
	 	PUSHBUTTO	N CRI PC	TOR CUIT	TOTE C					
 		LOSHBULLO	N SELEC	TOK 2MT	ICHES					
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l	ſ	1 2		3	4					
	i	OUT IN	. IN		OUT					
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		· · · · · · · · · · · · · · · · · · ·								
WE	LDING			OUND						
	LTAGE	· lammar			እየረ					
		14.5		1	NA NA					
	LDING .									
1	RRENT	156								
A	MPS	130			 		 			
	CURRENT				WIRE	•	AUTO	[
HE	SETTING	4.25			FEED PRO	•		Х		
REMOTE PENDANT	VOLTAGE	4.25			<u> </u>		MANUAL	Α		
图图	TRIM									
	SETTING	0					•			
				1	DOMESTIC CO.			-		
WIRE SPEED-IPM					POTENTIOMETER. SETTING					
25	CUD-ILM	343	<u> </u>		DETITING	3.	5			
	TRAVEL.									
SPEED-IPM		0 =					•			
		. 8.5	<u> </u>	· · - · -	·					
1										
E - 33										
HORIZONTAL										
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AIRCO PA-350 MACHINE SETTING

BASE			WIRE TYPE & DIAMETER			PROCESS SELECTOR				
MATERIAL .250" THICKNESS						PULSE		RT ARC		
.250" THICKNESS 5456 H-116					OV	COVER	CO	AR/C	7.	
	ALUMINUM ALLOY		5356 ALUMINUM AL			X	7	ROOT	X	
111101	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII									
		D GAS			FLOW RATE					
75	ZHE/25%AR	X			40 CFH					
				J" GRO		moves -				
		PUS	BUTTON	SELECT	OR SWI	TCHES				
	_									
		1	2	3		4				
		OUT	OU	I IN		OUT				
POS	ITION	OVERH	EAD							
WELDING VOLTAGE		14	26.2		BACKGROUND SETTING 0				,,,	
CUE	.DING RENT IPS	150	105	•						
	CURRENT					WIRE	·	COVER AUTO	x	
EN	SETTING	4.25	4.75			FEED PE	OCESS	RUUT MANUAL	X	
REMOTE PENDANT	VOLTAGE TRIM SETTING	0	0					•		
WIRE SPEED—IPM		348	282	•		POTENTIC SETTING	METER ROOT 3.75	COVE		
TRAVEL. SPEED—IPM		20.5	.13.6			•		•		
E-33	7		· 2.	50	<u> </u>	→ .325	\ \		>	

AIRCO PA-350 MACHINE SETTING



AIRCO PA-350 MACHINE SETTING

MATERIAL .250" THICKNESS .5083 H-321 ALUMINUM ALLOY SHIELD GAS 75ZHE/25ZAR PUSHBUTTON SELECTOR SWITCHES PUSHBUTTON SELECTOR SWITCHES PUSHBUTTON SELECTOR SWITCHES PUSHBUTTON SETTING WELDING VOLTAGE 1.5.7 WELDING CURRENT AMPS 1.30 CURRENT SETTING 5.0 WIRE SETTING WIRE SETTING O WIRE SETTING O WIRE SETTING O WIRE SETTING O WIRE SETTING 1.30 FEED PROCESS AUTO MANUAL F-3 VERTICAL-UP 1 PASS	Γ	BASE	1	RE TYPE &					
SHIELD GAS SHIELD GAS SHIELD GAS FLOW RATE 75ZHE/25ZAR PUSHBUTTON SELECTOR SWITCHES 1 2 3 4 OUT IN IN OUT WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL FEED TRAVEL SPEED-IPM 330 TRAVEL SPEED-IPM 330 F-3 VERTICAL-UP									
SHIELD GAS SHIELD GAS TEAWEL SHIELD GAS TEAWEL PUSHBUTTON SELECTOR SWITCHES PUSHBUTTON SELECTOR SWITCHES PUSHBUTTON SELECTOR SWITCHES BACKGROUND SETTING BACKGROUND SETTING WELDING CURRENT AMPS 130 WIRE SETTING SETTING VOLTAGE TRIM SETTING WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12.	I .				TOX	PULSE			
SHIELD GAS 75%HE/25%AR PUSHBUTTON SELECTOR SWITCHES 1 2 3 4 OUT IN IN OUT WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE TRIM SETTING 0 WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12.	I			DIAMETER	1		202		7
PUSHBUTTON SELECTOR SWITCHES 1	ALU	MINUM ALLOY					ļ	^	
PUSHBUTTON SELECTOR SWITCHES 1	}								
PUSHBUTTON SELECTOR SWITCHES 1 2 3 4 OUT IN IN OUT WELDING VOLTAGE 15.7 SETTING WELDING CURRENT AMPS 130 CURRENT 5.0 WIRE AUTO FEED PROCESS MANUAL X EXAMPLE SETTING 0 WIRE SETTING 0 WIRE SETTING 0 WIRE SETTING 330 3.5 TRAYEL SPEED-IPM 330 3.5 TRAYEL SPEED-IPM 12.		SHIEL	D GAS			FLOW RAT	ΪΈ		
WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12. F-3 VERTICAL-UP	7.	5%HE/25%AR				40 CFH			
WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12. F-3 VERTICAL-UP				•					i
WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12. F-3 VERTICAL-UP	 		PHCHRIT	ייים דער הריי	ירונים מחי	ਾ ਦਸ਼ਾਵ			
WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12.	├		r domed r	LION SELECT	LING AU.	CHES			
WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12.	ļ								,
WELDING VOLTAGE 15.7 WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12 BACKGROUND SETTING WIRE FEED PROCESS AUTO MANUAL POTENTIOMETER SETTING 3.5 TRAVEL SPEED-IPM 12	1								
WELDING CURRENT AMPS CURRENT SETTING SETTING TRIM SETTING O WIRE SPEED-IPM TRAVEL SPEED-IPM F-3 VERTICAL-UP			OUT I	N , IN		OUT			į
WELDING CURRENT AMPS CURRENT SETTING SETTING TRIM SETTING O WIRE SPEED-IPM TRAVEL SPEED-IPM F-3 VERTICAL-UP									
WELDING CURRENT AMPS CURRENT SETTING SETTING SETTING SETTING SETTING SETTING SETTING SETTING SETTING FEED PROCESS MANUAL POTENTIOMETER SETTING SETTING 330 TRAVEL SPEED-IPM 12 F-3 VERTICAL-UP	 								
WELDING CURRENT AMPS CURRENT SETTING SETTING SETTING CURRENT SETTING SETTING SETTING SETTING SETTING FEED PROCESS MANUAL POTENTIOMETER SETTING SETTING 330 TRAVEL SPEED-IPM 12 F-3 VERTICAL-UP									
WELDING CURRENT AMPS CURRENT SETTING SETTING TRIM SETTING O WIRE SPEED-IPM TRAVEL SPEED-IPM F-3 VERTICAL-UP	 	· prog			2.000	27772			
WELDING CURRENT AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE STTING O WIRE SPEED-IPM 330 TRAVEL SPEED-IPM 12 F-3 VERTICAL-UP	i			-	•				
CURRENT AMPS CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL WIRE SETTING O WIRE SPEED-IPM 330 F-3 VERTICAL-UP			15	.7	PETITIO	<i>3</i> 			
AMPS 130 CURRENT SETTING 5.0 WIRE FEED PROCESS MANUAL X VOLTAGE TRIM SETTING 0 WIRE SPEED-IPM 330 POTENTIOMETER SETTING 3.5 TRAVEL SPEED-IPM 12.		1		-					
CURRENT SETTING 5.0 FEED PROCESS MANUAL X VOLTAGE TRIM SETTING 0 WIRE SPEED-IPM 330 POTENTIOMETER SETTING 3.5 TRAVEL SPEED-IPM 12.	1	1	10						
VOLTAGE TRIM SETTING WIRE SPEED-IPM TRAVEL SPE	A	MPS	13						
SETTING 0 WIRE SPEED-IPM 330 TRAVEL SPEED-IPM F-3 VERTICAL-UP		CURRENT				WIRE		AUTO	
SETTING 0 WIRE SPEED-IPM 330 TRAVEL SPEED-IPM F-3 VERTICAL-UP	EE	SETTING	5	n		FEED PRO	CESS	MANITA	r:X
SETTING 0 WIRE SPEED-IPM 330 TRAVEL SPEED-IPM F-3 VERTICAL-UP	N ON	VOLTAGE		<u> </u>		1		14411011	٠.٠
SETTING 0 WIRE SPEED-IPM 330 TRAVEL SPEED-IPM F-3 VERTICAL-UP	四四								,
SPEED-IPM 330 SETTING 3.5 TRAVEL SPEED-IPM 12 F-3 VERTICAL-UP		SETTING	00					•	
SPEED-IPM 330 SETTING 3.5 TRAVEL SPEED-IPM 12 F-3 VERTICAL-UP		WTRE				POTENTIOM	ETER		
TRAVEL SPEED-IPM F-3 VERTICAL-UP	SP								ļ
F-3 VERTICAL-UP	-		330					3.5	
F-3 VERTICAL-UP		1						•	
F-3 VERTICAL-UP	SP	EED-IPM	40						
VERTICAL-UP									
VERTICAL-UP	1								
•	F-3	3							
1 PASS	VE	RTICAL-UP							
1 PASS				•					
			1 PAS	S					

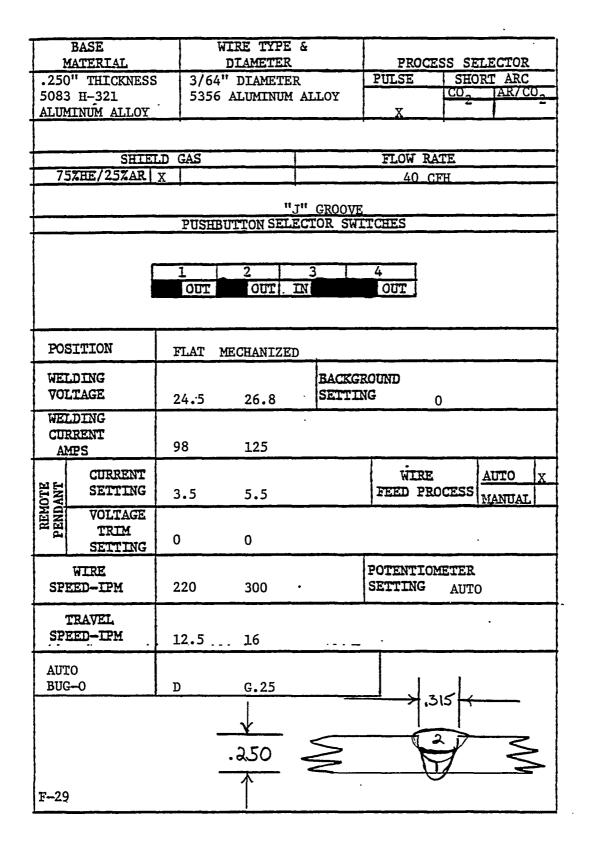
AIRCO PA-350 MACHINE SETTING

Ţ	BASE		WIRE TYPE &									
1	MATERIAL			DIAM	ETER			1	PROCE	SS SI	ELECTOR	
.25	O" THICKNES	SS			- •			PU	LSE		ORT ARC	
5	083 H-321	Ì	5	556 A	LUMI	NUM	[ALLO	¥		CO ₂	AR/C	<u>) </u>
	MINUM ALLOY		3/6	4" DI	AMET	ER					X	
		•						•		•		
ļ	011777					,			TOTT DA	mra.	 	
7	SHIE 5%HR/25%AR	<u> </u>		00% 11					LOW RA			
-	Utelik - in Utelike		<u>+</u>	00% H	<u> </u>				00_CFH			—
ł												
 		PU	JSHBU	TTON	SEL	ECT	OR SW	LTCH	ES		· · · · · · · · · · · · · · · · · · ·	
												
1	_											
		1		2		3		4				
			OUT	IN		IN		0	UT			
1									-			
<u> </u>												
1												
 						\neg						
WE	LDING	1					BACKG	ROUN	D			
VO :	LTAGE	1 1	14.5 SETTI					NG	N.	٨		
WE	LDING	 	. 4 . 5						N.	<u> </u>		
	RRENT	1				·						
1	MPS	1	45									
								1				
田田	CURRENT SETTING	1						-	WIRE		AUTO	
REMOTE PENDANT		4	.5					FF	ED PRO	CKZZ	MANUAL	X
EN	VOLTAGE	1										
E E	TRIM	١.										
	SETTING	0									·	
1	WIRE							POI	ENTION	ŒTER		
SP	EED-IPM	2	33			•			TING			
 		 						1		3	•5	
	TRAVEL										•	
SP:	EED-IPM	1	.0.2.	· -			·					
		<u></u>										
1												
,	F-13											
	HORIZONTAL											
1												
1												

AIRCO PA-350 MACHINE SETTING

	BASE	Ţ	VIRE TYPE			_
M	ATERIAL		DIAMETER		PROCESS SELECTOR	_
.250	" THICKNESS		' DIAMETI		PULSE SHORT ARC	_
5083	3 H-321	5356	ALUMINUM	I ALLOY	COVER - Z	÷
ALUM	INUM ALLOY				X X ROO	T
					OT DAME	_
		D GAS			FLOW RATE	
75	ZHE/25%AR	<u> </u>			40 CFH	
		PUSHI	"J" GRO BUTTON SEI	OOVE LECTOR SW	ITCHES	
:		1 OUT	OUT .	3 IN	4 OUT	
POS	SITION	OVERHE	AD			
	DING TAGE	14	25	BACK(GROUND ING 0 0	
CUI	DING RRENT IPS	158	96		WALLEY TO A	
OTE ANT	CURRENT SETTING	4.5	3.5		WIRE COVER AUTO FEED PROCESS ROOT MANUAL	X X
REMOTE PENDANT	VOLTAGE TRIM SETTING	0	0			
SP	WIRE EED—IPM	370	230	•	POTENTIOMETER SETTING 4 AUTO	
I	IRAVEL EED—IPM	21.5	15.6		- ·	
2	PASS_	-		,250 T	→\.32 	₹

AIRCO PA-350 MACHINE SETTING



AIRCO PA-350 MACHINE SETTING

	BASE ATERIAL		WIRE TO			PROCESS SELECTOR				
	THICKNESS	3/6	4" DIAM			PULSE		ORT ARC		
	6 H-116		66 ALUMI		.T.0Y	2 thru 6	CO	AR/CO2		
1	MINUM ALLOY		, , , , , , , , , , , , , , , , , , , ,			X	1	X ROOT		
		LD GAS			FLOW RATE					
1 /5	ZHE/25%AR	X		_		40 CFH				
 		PIISI	BUTTON	J" GRO		TCHES				
 			IDOI LOIK							
	1	1	2	3		4				
		OUT	OU	r IN		OUT				
POS	ITION	VERTIC	CAL							
WET	DING	17.5	26.5	26.5	BACKGI	ROUND				
I .	TAGE	26.5	26	26	SETTI		0	1		
<u></u>						···				
	LDING RRENT	145	130	120						
	æni Øs	120	110	110						
	CURRENT	6	6	5		WIRE		2-6 AUTO X		
田田	SETTING	5	4.5	4.5		FEED PRO	CESS	ROOT		
REMOTE PENDANT								MANUAL X		
	VOLTAGE	1	0	0						
P4	TRIM SETTING	ō	ī	í				•		
-						200000000				
	WIRE	370	327	290		POTENTION	ETER ROOT	AUTO		
SPI	EED-IPM	290	272	272		SETTING 1	4	2 thru 6		
	TRAVEL	25.5	12.9	19.1						
		19.1	18.3	18.3			•	· ·		
1		<u> </u>	. =			•				
WEL	D SEQUENCE	1	2 5	3 6						
		4	5	6		5	1	. 6		
						°√> .525				
					-	1000				
							<u> </u>			
					.50			≥		
					*	<u> </u>		~		
<u></u>		 								

AIRCO PA-350 MACHINE SETTING

	BASE ATERIAL	1	TRE TY			PROCESS	SEL	ECTOR
						PULSE		T ARC
	HICKNESS		' DIAM			2 thru 6 (202	AR/CO2
ALUM	H-116 INUM ALLOY	5356	ALUMII	NUM AL	TOX	A		X ROOT
								1
		616				FLOW RATE	₹.	
	SHIEL		HELIU			40 CFH		
/3	ZHE/25ZAR	100%	HELLU	TIA		<u> 40 GFR.</u>		
			•	"J" GE	ROOVE			
 		PUSHB	UTTON S	ELECT	OR SWI	TCHES		
				, ,				
I		1	2	3		4 OUT		
İ		OUT	נטס	I. IN		001		
 			· · · · · · · · · · · · · · · · · · ·					
PO	SITION	HORIZO	NTAT.			•		
 				26	DA CITATI	OUBID		
1	DING	17.8	27.2	26 28	BACKGI		0	
AOI	TAGE	. 26	28		SELLIN		<u> </u>	
WEI	DING	145	138	115				
CO	RRENT	1:15	120	120				
Al	ÆS							2-6
1 1	CURRENT	6	7	5		WIRE	ŧ	AUTO X
범텆	SETTING	5	5	5		FEED PRO	TESS	RUUT MANUAL X
REMOTE PENDANT	VOLTAGE							
EE	TRIM	1	0	0				
P-1	SETTING	0	2	2				
		412	367	290		POTENTIOM	ETER	
-	WIRE	290	290	290		SETTING RO	TOC	AUTO 2 thru 6
SP	EED-IPM	270	270			3E111RG 4.	.0	2 thru 6
	TRAVEL	0.1						•
	EED—IPM	24	15	17.9				
1		1/.9.	18.7	18.7		·		
İ								
W	ELD SEQUENCI	E: 1 4	2 5	3 6				
		4	5	6				
						6 ,	1	_5
1						14	5 25	√ ,3
					50	+ S &	Z	
					•30	*	₩	
I						<u> </u>		

AIRCO PA-350 MACHINE SETTING

					,			 ,
1	BASE		WIRE TYPE					
	ATERIAL		DIAMETER				LECTOR	
	6-H116		3/64" Dia.		PULSE		RT ARC	
15"	Thick		356 ALUMIN		X 2-5	CO ₂	X ro	
ALI	JMINUM ALLO	Y J.	220 ALUMIN	OH ALLOI	Α		A 10	JOL
		· ·			•	,		
				 	TT 017 714	mrz.		
		LD GAS			FLOW RA	T.E.		
75	ZHE/25%AR X	<u> </u>			40 CFH			
		1	"J" Groove	.				
			BUTTON SEL		TCHES			
	7	LOSII	DOLLOW COT	201010 011				
[1	1	2	3	4			
		OUT	OUT .		OUT			
		001	0011.					
		Γ					·	
POS	SITION	ov	ERHEAD					
1	LDING		5.1 27.4	,	-	_		!
A01	TAGE	27.2 2°	7.2	SETTI	NG	0		
ਪਲਾ	DING							
1	RENT	150	120	132				
	æs	128	128					
 	IF 3				1		2-5	
1	CURRENT	5.5	5.0	6.5	WIRE		AUTO	X
	SETTING	6	6		FEED PRO	CESS	TOOL MANUAL	X
REMOTE PENDANT	VOLTAGE	 			<u> </u>		THANUAL	
恩恩		1	00					
24	TRIM	.5	•5				•	
1	SETTING	 			ı			_
1	WIRE	385	290	350	POTENTION	METER	2-5	
SPI	ZED-IPM	325	325	•	SETTING	FOOT 4 25	Auto	
			·····		<u> </u>	+.43		
1 .	trayel	21	12.7	12.9			•	
	EED-IPM	19.1	19.1		_			
1		<u> </u>			·	····		
Wel	d Sequence	123						
1	-	45						
1			1	عر	3 1			
1			1	\	→ ,565 ←			
1								
1			1/2"	~	V-7		<	
1			<u>-2</u>	<u> </u>			\leq	
1	G-16				- 744 -			
1	G-10		Į		4 5 3			
								

AIRCO PA-350 MACHINE SETTING

ATERIAL	1	DIAME	CPE &	1	PROCESS SELECTOR						
					PULSE		RT ARC				
5-H116 Thick		/64" Di			2-5	CO,	AR/CO_				
MINUM ALLOY		5556 AL	UMINUM	ALLOY	/X		root X				
SHIEL	D GAS			FLOW RATE							
ZHE/25%AR I	K				40 CFI	<u> </u>					
		"J" Groove									
	PUSE	BUTTON	SELECT	OR SWI	TCHES						
	1 · OUT	2			4 OUT		·				
ITION	OVE	ERHEAD		· · · · · · · · · · · · · · · · · · ·							
DING TAGE	16.5 27.2	26.8 28	27.2			0					
DING RENT IPS	145 128			125							
CURRENT SETTING	5.5 6.0			6.0			AUTO X FOOT MANUAL X				
VOLTAGE TRIM SETTING	1 .5	0 0 1									
WIRE SED-IPM	375 325	325 325	325	5							
TRAVEL EED—IPM				12.9			·				
		3		\$"	2	.56					
	ITION DING TAGE DING RENT PS CURRENT SETTING VOLTAGE TRIM SETTING WIRE MIRE MIRE MIRE MIRE MIRE MIRE MIRE M	PUSE THE/25%AR X PUSE 1 OUT OUT OUT TION OVE TAGE 16.5 27.2 DING 145 128 CURRENT SETTING VOLTAGE TRIM SETTING VOLTAGE TRIM SETTING WIRE 375 325 TRAVEL 24 19.1 d Sequence 1 2 4 5	### ### ### ### ### ### ### ### ### ##	### ##################################	### CHE/25% AR ### CH	THE	THE 25 26 27 28 28				

AIRCO PA-350 MACHINE SETTING

	DAGE		WIRE TYPE	· · · · · ·	_				
	BASE		DIAMETER		-	שטחתבי	20 01	LECTOR	
	ATERIAL		DIAMETER		┿	PULSE		ORT ARC	
	' THICKNESS	1 22-	6 ALUMINU		H	FULSE	CO		
	5 H-116	3/6	64" DIAMET	ER	1	х .	2	-	2
ALU	ITNUM ALLOY				+		 		
		GROOVE							
		LD GAS				FLOW RA			
75	%HE/25%AR	X				40 CF	<u> </u>		
		PUSHI	BUTTON SEI	ECTOR ST	VI.	CHES			
		1 OUT	IN.	3 IN		4 OUT			
POS	SITION		FLAT						
	DING TAGE		3 4 27.2 26.2	5 BACK 27.5 SETT		_	•0		
l .	DING RENT	1 122	2 152	3 165		4 155	5 165		
AM	œs	122	132	702		T22	T0:) 	
	CURRENT		0 0	,	-	WIRE		AUTO	
D E	SETTING	1	2 3	4	5	FEED PRO	aree		+
AN		4 !	5.5 6	5.5	6	FEED PRO	ددعار	MANUAI	X
	VOLTAGE	1	2	3		4	5		
REMOTE PENDANT	TRIM	0 -				•		_	
	SETTING	U	2	2		2	2	· 	
	WIRE				Ţ.	POTENTION	משיים		
SPE	EED-IPM	1 2 300 320	3 4 3 408 368	5 402		SETTING 1	2	3 4 4.5 4	5 4.5
		1	2	3			-	<u> </u>	
	TRAVEL	24.7	16.8	16.8	,	4 22.1		9.1	
SPE	EED-IPM	24.7	10.0	TO . C) 	. 44.1	Т;	7•± ————	
									
			**						
,									
					£	.575	5	>	
					Z _		`\	>	

AIRCO PA-350 MACHINE SETTING

L .	BASE MATERIAL			TYPE METER	&		PROCE	SS SE	SELECTOR		
	THICKNESS	3/6		AMETEI	{		PULSE		RT ARC		
1	6 H-116			MINUM		LOY	2-5	CO,	AR/CO		
	MINUM ALLOY						x	1	ROOT	x	
	·										
		D GAS					FLOW RA				
75	ZHE/25%AR	X				· · · · · ·	40 C	FH		-	
		PUSE	BUTTO	"J" ON SELI			ITCHES			_	
	6	1 OUT	IN.		3	OUT	4 OUT				
PO	SITION	VERTI	CAL								
	DING TAGE	17.5 27.1	25 27.1	26.8	•	BACK(ROUND ING	0			
CUF	LDING RRENT IPS	145 122	125 122	130							
OTE	CURRENT SETTING	6 5	5 5	6			WIRE FEED PRO	OCESS	POOT	X X	
REMOTE PENDANT	VOLTAGE TRIM SETTING	1	0 1	0					`		
SPI	WIRE ED-IPM	370 292	290 292	335	•		POTENTION SETTING		2-5 AUTO		
1	TRAVEL EED—IPM	24 14.2	11.2 . 15.9	12			_ ·		•		
WEL	D SEQUENCE	1 4	2 5	3		2 4	,52	5	,3		
H-5							·				

AIRCO PA-350 MACHINE SETTING

	BASE ATERIAL			E TYPE		·	PROCE	SS SE	LECTOR
							PULSE		RT ARC
_	HICKNESS		-	DIAMETE		t	2-6	CO,	AR/CO
ALUM ALUM	H-116 INUM ALLOY	5.	356 A	LUMINUM	1 AL	TOA	X	1 2	X ROOT
	SHT N	LD GAS	•	·····	1		FLOW RA	TE	
75	%HE/25%AR		00% H	EX	┼─		40 CFH	1111	
13	ARE/ ZJAAR_		00% II				40 CFH		
		DII	CHRIIT	"J" G TON SEL			TCHES		
		10	311101	TON CLL					
	ſ	1		2	3	·	4 1		
		Ot	T I		_	OUT	OUT		
	•								
		l .			 = .				,
POS	ITION	HORI	ZONTA	<u>. </u>					
WEL	DING	16	26	29		BACKGR	OUND		
AOL	TAGE		26.8	-		SETTIN	G	0	
WEI	DING				•				
CUR	RENT	135	118	135					
AM	PS	130	130	125			. 		
	CURRENT	6	5	7			WIRE		2-6 AUTO
범턴	SETTING	5.5	5 . 5	5.5			FEED PRO	OCESS	ROOT
REMOTE PENDANT	VOLTAGE	 					<u> </u>		MANUAL X
물집	TRIM	1	0	1					
14	SETTING	1	1	1.					
	WIRE	380	290	372			POTENTIO		
SPE	ED-IPM	312	312	312	•		SETTING R	.00T 4	2-6 AUTO
7	RAVEL	20 5	10 1	12 5					
	ED-IPM	16.8	19.1 14,2	26.3			•	•	
		·					MM		,a ,
MET	SEQUENCE	1 4	2 5	3 6			, v,		6
		4	ر	υ			. .	/	_5 ↓
							LAT		.56
							デンバル		. 377
							(Z)		,
								//	
							W		-41

AIRCO PA-350 MACHINE SETTING

	BASE ATERIAL	WIRE TYPE DIAMETER	&	PROC	ESS SE	LECTOR
	THICKNESS	3/64" DIAMETE	R	PULSE		RT ARC
_	6 н-116	5356 ALUMINUM	ALLOY	2-5	CO,	AR/CO
ALUI	MINUM ALLOY			х	2	ROOT X
	SHIEL	D GAS	Ī	FLOW R	ATE	·
75	ZHE/25%AR >			40 C		
		"J" G				
		1 2 OUT IN	3 OUT	4 OUT		
POS	SITION	OVERHEAD		·		
	DING TAGE	16 25 27 27.2 27.2	BACKG SETTI		0	
CUF	.DING RRENT IPS	150 125 125 132 132				
OTE ANT	CURRENT SETTING	5 5 6 6 6		WIRE FEED PR		2-5 AUTO X ROOT MANUAL X
REMOTE PENDANT	VOLTAGE TRIM SETTING	1 0 .5 1 1				···
SPI	WIRE ZED-IPM	390 290 330 314 314	•	POTENTIC SETTING		2 - 5 AUTO
	ravel EED—IPM	20 12.4 12.2 16.2 16.2	- ·· -	· · · · · · · · · · · · · · · · · · ·	•	
WE	LD SEQUENCE	1 2 3 4 5				
н	4	1/2" =		575 ×		\(\)

AIRCO PA-350 MACHINE SETTING

	BASE ATERIAL			TYPE ÆTER	&		PROCE	ESS SE	LECTO	OR
	THICKNESS	3/6	4" DI		?		PULSE	SHO	RT AI	RC
_	6 H-116		6 ALU			Y		CO,	AR	/CO,
	MINUM ALLOY					- 1	X			
		D GAS					FLOW R	ATE-		
75	%HE/25%AR	X					40_CF	HH		
		PUSI	BUTTO	"J" GE ON SELL			TCHES	·····		
		1 OUT	2 IN		3	UT	4 OUT			
POS	SITION	FLAT	MECHA	NIZED						
	.DING .TAGE	25.2 27.5	27 27.5	29		ACKGI ETTIN	_	5 5 5	5	,, <u>, , , , , , , , , , , , , , , , , ,</u>
CUI	.DING RRENT IPS	147 122	140 122	148						
OTE ANT	CURRENT SETTING	4 6	6.5 6	7.5			WIRE FEED PR		AUTO	AL X
REMOTE PENDANT	VOLTAGE TRIM SETTING	0								
SPI	WIRE EED-IPM	358 300	370 300	370	•		POTENTIC SETTING	METER 4 3.25	4 3.25	4
	TRAVEL EED—IPM	19.5 17.2	12.5 17.2	12.5			BUG-O SETTINGS	J.5	Đ H	D
WEL	D SEQUENCE	1 4	2 5	3		۵.	4 50		,5 -	
н –6			 -	***	Y	<u> </u>				, >

AIRCO PA-350 MACHINE SETTING

BASE SATERIAL			E TYP		•	PROCE	SS SE	LECTOR	
	3					PULSE	SHC	RT ARC	
					LOY	2-6	CO	AR/C	0,
					.201	1	1 -	X RO	OT.
		<u> </u>							
THE/25%AR	X			Ц.,	·	40	CFH		
	PU	SHBUT				ITCHES			
	1 Ot	T I	2			4 OUT			
ITION	VERT	ICAL-1	JP		<u></u>				
LDING LTAGE	17 26	26 25.8	26 25.8	-			0		
LDING RRENT MPS	140 118	130 112	118 110						
CURRENT SETTING	6 5	6 4.5	5 4.5			WIRE FEED PR	OCESS	AUTO ROOTAL	X
VOLTAGE TRIM SETTING	1 0	0 •5	0 0						.•
WIRE EED-IPM	372 290	325 275	290 275	•		SETTING	METER ROOT 4.0	2-6 AUTO	
TRAVEL EED—IPM							•	•	•
D SEQUENCE	1 4	2 5	3 6				•	-	
.7				4 4	Na"	6 .55	3	/° <u> </u>	
	THICKNESS 3 H-321 MINUM ALLOY SHIED ZHE/25%AR ITION LDING TRAGE LDING REENT SETTING VOLTAGE TRIM SETTING WIRE ZED-IPM FRAVEL EED-IPM D SEQUENCE	THICKNESS 3.3 3 H-321 5.5 MINUM ALLOY SHIELD GAS ZHE/25%AR X PU TION VERT: LDING 17 TAGE 26 LDING 17 TAGE 26 LDING 140 118 CURRENT 6 SETTING 5 VOLTAGE TRIM 5 VOLTAGE TRIM 0 SETTING 0 WIRE 372 ZED-IPM 290 FRAVEL 22.1 EED-IPM 19.1	THICKNESS 3/64" 1 5356 AI MINUM ALLOY	THICKNESS 3/64" DIAMETE 3/64" DIAMETE 5356 ALUMINUM ALLOY 5356 ALUMINUM ALUMINUM ALLOY 5356 ALUMINUM ALUMINUM ALLOY 5356 ALUMINUM ALUMINUM ALUMINUM ALLOY 5356 ALUMINUM ALUMINUM ALUMINUM ALUMINUM ALLOY 5356 ALUMINUM	DIAMETER THICKNESS 3/64" DIAMETER 5356 ALUMINUM AL	THICKNESS 3/64" DIAMETER 3/64" DIAMETER 3/64" DIAMETER 5356 ALUMINUM ALLOY 5	THICKNESS 3/64" DIAMETER PROCES 3/64" DIAMETER PULSE 3/64" DIAMETER PULSE 3/64" DIAMETER 2-6 X X X X X X X X X	DIAMETER	ATERIAL DIAMETER PROCESS SELECTOR THICKNESS 3/64" DIAMETER PULSE SHORT ARC 3 H-321 SHORT ARC X K K K K K K K K K K K K K K K K K K

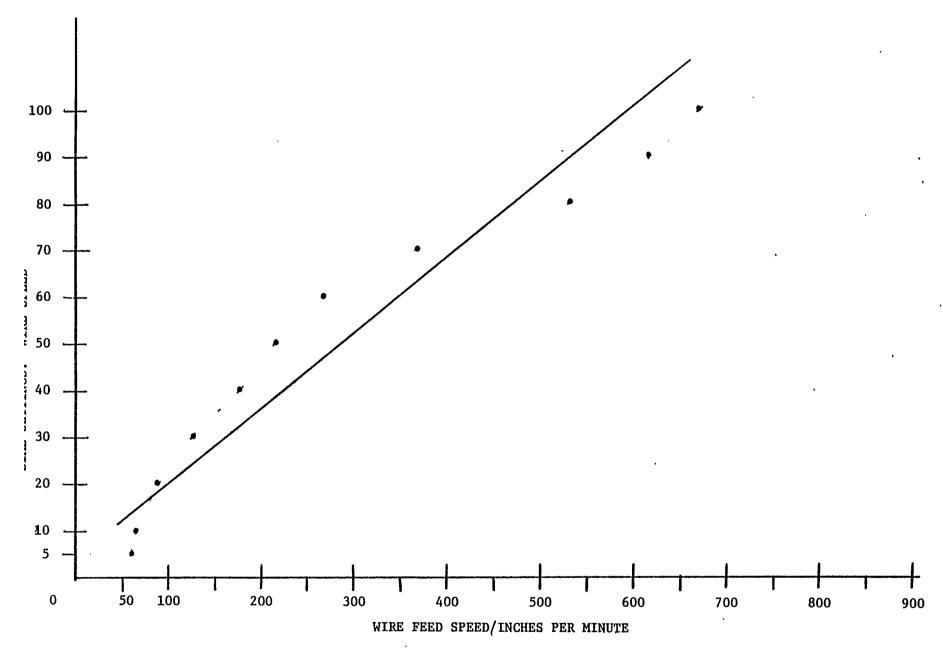
AIRCO PA-350 MACHINE SETTING

MATERIAL		BASE		WIRE '	TYPE &				
THICKNESS 5366 ALUMINUM ALLOY			1				PROCE	ESS SE	ELECTOR
SHIELD GAS			3/6				PULSE		
SHIELD GAS						LLOY	2-6	CO,	AR/CO
TSTHE	1	_	L				X		X ROOT
TSTHE		,							
TSTHE/25%AR		SHIEI	D GAS			·	FLOW RA	ATE	
PUSHBUTTON SELECTOR SWITCHES 1	75			% HE	X	*	40 CF	I	
PUSHBUTTON SELECTOR SWITCHES 1				ff 7	ייי באטר ייי באטר	N7F			
POSITION HORIZONTAL WELDING 16.2 25.8 28.2 BACKGROUND SETTING 0 WELDING 138 120 138 135 133 134 AMPS CURRENT 6 5 7 WIRE SETTING 6 6 6 6 FEED PROCESS ROUT MANUAL Y SETTING 1 1 1 1 WIRE 380 295 372 FOTENTION SETTING ROUT 2-6 AUTO 4 AUTO 4 AUTO 4 AUTO 5 AUTO 5 AUTO 6 AUTO 6 AUTO 6 AUTO 6 AUTO 6 AUTO 7 AUTO 6 AUTO 7		· · · · · · · · · · · · · · · · · · ·	PUSH				TCHES		
POSITION HORIZONTAL WELDING 16.2 25.8 28.2 BACKGROUND SETTING 0 WELDING 138 120 138 135 133 134 AMPS CURRENT 6 5 7 WIRE SETTING 6 6 6 6 FEED PROCESS ROUT MANUAL Y SETTING 1 1 1 1 WIRE 380 295 372 FOTENTION SETTING ROUT 2-6 AUTO 4 AUTO 4 AUTO 4 AUTO 5 AUTO 5 AUTO 6 AUTO 6 AUTO 6 AUTO 6 AUTO 6 AUTO 7 AUTO 6 AUTO 7									
POSITION HORIZONTAL WELDING 16.2 25.8 28.2 BACKGROUND SETTING 0 WELDING 138 120 138 135 133 134 AMPS CURRENT 6 5 7 WIRE SETTING 6 6 6 6 FEED PROCESS ROUT MANUAL Y SETTING 1 1 1 1 WIRE 380 295 372 FOTENTION SETTING ROUT 2-6 AUTO 4 AUTO 4 AUTO 4 AUTO 5 AUTO 5 AUTO 6 AUTO 6 AUTO 6 AUTO 6 AUTO 6 AUTO 7 AUTO 6 AUTO 7		_		1 2		3 1	4		
POSITION HORIZONTAL WELDING 16.2 25.8 28.2 BACKGROUND 0 WELDING 138 120 138 CURRENT 135 133 134 AMPS CURRENT 6 5 7 WIRE AUTO VALUE OF FRED PROCESS NANUAL VAL									,
WELDING VOLTAGE 25.8 28.2 27.8 SETTING 0 WELDING 138 120 138 135 133 134 AMPS CURRENT 6 5 7 WIRE SETTING 0 YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT 2-6 AUTO YELD PROCES		•							
WELDING VOLTAGE 25.8 28.2 27.8 SETTING 0 WELDING 138 120 138 135 133 134 AMPS CURRENT 6 5 7 WIRE SETTING 0 YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT MANUAL YELD PROCESS ROOT 2-6 AUTO YELD PROCES						· · · · · · · · · · · · · · · · · · ·	 		
VOLTAGE 27.5 27.8 27.8 SETTING 0	POS	ITION	HORIZ	ONTAL					
VOLTAGE 27.5 27.8 27.8 SETTING 0	WET	DING	16.2	25.8	28.2	BACKC	מזאזט		
WELDING 138 120 138 135 133 134 135 133 134 135 133 134 135 133 134 135 135 133 134 135 135 135 135 136				27.8				0	
CURRENT AMPS 135 133 134 CURRENT 6 5 7 WIRE ROTT WANUAL Y SETTING 1 1 0 0 TRIM SETTING 1 1 1 WIRE SPEED-IPM 332 332 332 POTENTIOMETER SETTING ROOT 2-6 AUTO Y AUTO Y ROOT Y ROOT Y MANUAL Y POTENTIOMETER SETTING ROOT 2-6 AUTO TRAVEL SPEED-IPM 20.5 19.1 13.1 17 12.9 26.3 WELD SEQUENCE 1 2 3 4 5 6			100	100	7.00				
AMPS CURRENT 6 5 7 WIRE ROUT Y AUTO Y ROUT Y AUTO WIRE 380 295 372 POTENTIOMETER SPEED-IPM 332 332 332 SETTING ROOT 4 AUTO TRAVEL SPEED-IPM 17 12.9 26.3 WELD SEQUENCE 1 2 3 4 5 6	1	•							
CURRENT SETTING 6 6 6 6 FEED PROCESS ROOT X NANUAL X VOLTAGE TRIM 1 1 1 WIRE 380 295 372 POTENTIOMETER SPEED-IPM 332 332 332 SETTING ROOT 2-6 AUTO TRAVEL SPEED-IPM 17 12.9 26.3 WELD SEQUENCE 1 2 3 4 5 6	1		133	133	134				
SETTING 6 6 6 6 FEED PROCESS ROOT MANUAL WINE SPEED-IPM 332 332 332 SETTING 2-6 AUTO WINE SPEED-IPM 17 12.9 26.3		CHEDENT	6	5	7		שפדעו		A TITTO
SETTING 1	되는	1							ROOT
SETTING 1	PE						FEED FR	ددعان	MANUAL X
SETTING 1	自然		1	0	n				
WIRE 380 295 372 POTENTIOMETER SPEED-IPM 332 332 332 SETTING ROOT 2-6 AUTO TRAVEL SPEED-IPM 20.5 19.1 13.1 17 12.9 26.3 WELD SEQUENCE 1 2 3 4 5 6	1 2								
SPEED-IPM 332 332 332 SETTING ROOT 4 2-6 AUTO TRAVEL SPEED-IPM 20.5 19.1 13.1 17 12.9 26.3 12.9 <t< td=""><td> </td><td>SETTING</td><td></td><td></td><td></td><td>· · · · · · · · · · · · · · · · · · ·</td><td></td><td></td><td></td></t<>	 	SETTING				· · · · · · · · · · · · · · · · · · ·			
SPEED-IPM 332 332 332 SETTING ROOT 4 2-6 AUTO TRAVEL SPEED-IPM 20.5 19.1 13.1 17 12.9 26.3 WELD SEQUENCE 1 2 3 4 5 6 2 3 4 5 6 <td>1</td> <td>WIRE</td> <td>380</td> <td>295</td> <td>372</td> <td></td> <td>POTENTIO</td> <td></td> <td></td>	1	WIRE	380	295	372		POTENTIO		
TRAVEL 20.5 19.1 13.1 17 12.9 26.3	SPI	ZED-IPM	332	332	332 ·		SETTING		
SPEED-IPM 20.5 19.1 13.1 12.9 26.3 WELD SEQUENCE 2 3 4 5 6 56 56 56 56 56 56	 					· · . · . · . · . · · · · · · · ·	<u> </u>	4	AULU -
WELD SEQUENCE 1 2 3 4 5 6 56 56	1		20.5	19.1	13.1				•
WELD SEQUENCE 1 2 3 4 5 6 5 6 5 5 6	SPI	EED-IPM							
4 5 6			_				Λ /\A	/a	.6 1
.56	MET	D SEQUENCE			3			//	
\(\frac{1}{2} \)	1		4	5	6		(AST		
\(\frac{1}{2} \)	1						(B)(B)		.56
T-21	1						144)		
W									个
	}						W		Į
T-21									
· · ·	I-2	1					コル		

AIRCO PA-350 MACHINE SETTING

									
1	BASE	- 1		TYPE		į	770		T T CMOD
I	ATERIAL			METER					LECTOR
	THICKNESS		3/64" DIAMETER 5356 ALUMINUM_ALLOY				PULSE		ORT ARC
L .	3 н-321		66 ALUN	IINUM,	ALI	TOA	2-6	CO ₂	AR/CU2
ALU	MINUM ALLOY						X		X ROOT
1							•		
ļ									
		LD GAS			<u> </u>		FLOW RA	TE	
75	ZHE/25%AR	X					40_0	FH	
1			-						•
				J" GR	700	E CONTRACTOR	2000		
		PUS	SHBUTTO	DN SEL	FCI	OR SWI	TCHES		
1									
1									
1	1	<u> </u>	2		3		4		
1	1	OU	T IN			OUT	OUT		
1									
									
POS	ITION	OVERE	ŒAD						
									
WEL	DING	15.8	26.5	26		BACKGR	OUND		
	TAGE	26	26.5	26.5		SETTIN		0	
1									
	DING	145	132	118	٠				
CUR	RENT	118	105	105					
AM	PS								
1 1	CURRENT	5	6	5			WIRE		2-6 AUTO X
떠든	SETTING	5	4.5	4.5			FEED PRO	20000	
	OHILING						FEED PRO	JUESS	ROOT MANUAL X
REMOTE PENDANT	VOLTAGE	1	0	0 .					
MEN I	TRIM	ō	1	1					
<u> </u>	SETTING	0	_ <u>_</u>	<u>.</u>					
	WIRE	390	328	200			POTENTION	מיניתים»	
1	WIRE ED-IPM	290	328 275	290		1	SETTING	ROOT	2-6
SrE		290	4/3	275			CHITING	4.25	
	TO A TOOT								
	RAVEL	21	12.6	17.6					٠
) SPE	ED-IPM	17.6	13.9-	13.9			<u> </u>		
WELI	SEQUENCE	1	2 5	3					
{		4	5	3 6					
ļ				لا	_				
ļ				1/	["	> -			~
ł						\geq	بحرير		
Ī				1	•	_	///		
}	•			l				//	\
1.						×3	/→ ,565	←\ ¿	4
I-16	5					~5	·	0	

AIRCO PA-350 MACHINE SETTING



WIRE FEED SPEED VS. DIAL SETTINGS 3/64" DIAMETER 5556 ALUMINUM ALLOY FILLER WIRE GILLILAND MTG 4001 FEEDER; MTG 2000 GUN

		,	/ERTI	CAL-I	1P	E	IORIZ	ONTAL			OVERI	HEAD			FL	ΑT		
A	.063" 5086			XX	-		•									ХХ		5356
Α.	H-32								•				·~					5556
В	.100" 5086															xx		- 5356
	н-32		XX												•			5556
С	.125" 5083															хх		5356
	H-323		xx ²				XX											5556
D	.250" 5086	ļ.								·								5356
	H-116																	5556
E	.250" 5456 H-116																	5356
	H-110			,														5556
F	.250 ⁴ 5083 H-321									-				:				5356
	R-321													•	-			5556
G	.500" 5086															xx		5356
	н-116									`			•					5556
H	.500" 5456																	5356
	H-116																	5556
I	.500" 5083				<u> </u>						•	·			ţ	xx	,	5356
	н-321		ļ		<u> </u>													5556
		030	035	<u>3</u>	$\frac{1}{16}$	030	.035	<u>3</u>	$\frac{1}{16}$	030	.035	<u>3</u>	<u>:1</u> 16	030	.035	3 64	$\frac{1}{16}$	

BASE	WIRE TYPE	£	1	PULSE	
MATERIAL	DIAMETER			CESS SELECTOR	λ.
.063" THICKNE	SS		120	60	
5086 H-32	5356 ALUM. A	ALLOY		77	
ALUMINUM ALLO	Y 045" DTAME	'ER		X	
SHIE	LD GAS		FLOW	RATE	
75%HE/25%AR		<u> </u>	40 CFF		
		+			
		<u> </u>			
Tym		SWITCHE			
EXI	RA LOW		NOR	MAL	
			BILIZER		
		ENE	RGIZER	- OFF	
		1			
<u></u>					
1					
	- 11/11 - 11/2 				
WELDING VOLTAGE					
<u> </u>	. 9.8			•	
WELDING				•	
CURRENT	42		•		
AMPS	42			···	
POSITION					
	VERTICAL-UP				
VOLTAGE	BACKGRO	י תאוזו		PEAK	
SETTING		•	1		
	<u> </u>	.0		4.75	
WIRE		•	•	IOMETER	
SPEED-IPM	110	•	SETTIN	G 24	
TRAVEL			 		
SPEED-IPM					
	19	·	·	·	
	- 2000 - FEEDER				
	G - 4001 - AIR-CO D AMP	OLED GUN			
400	HIII.				
		•	•		
1					;

BASE	WIRE TY	E &	P	ULSE
MATERIAL	DIAMET			SS SELECTOR
.063" THICKNES	1 '		120	60
5086 H-32	5356 ALUMIN	TUM ALLOY		x
ALUMINUM ALLOY				A
SHIEL	D GAS	T	FLOW RA	TE.
75%HE/25%AR			40 CFH	·
	SELECT	OR SWITCHE	S	
EXT	RA LOW		NORMA	L
•	AT			
		STARI	ILIZER - L	OW
			SIZER - O	
,				
		<u>'</u>	······································	
WELDING				
VOLTAGE	13.5		•	•
WELDING				
CURRENT				
AMPS	50			
DOCTOR				
POSITION	MECHANIZED FL	ΑfT	-	•
	FECHANIZED FL	WT.		
VOLTAGE	BACKG	ROUND	P:	EAK
SETTING	3.	5	-	4.25
WIRE			DOMESTIC C	(CENTED
SPEED-IPM	100	•	POTENTION SETTING	
	130		SELLING	31
TRAVEL				
SPEED-IPM	24.5	_		
			4,77770	
Metro	- 2000 - FEEDI	೯ರ	AUTO BUG-O	L.75
1	- 4001 - AIR-			<u> </u>
1	AMP.	COLLED GOM		•
1				
A1.34				

BASE	WIRE TYPE	Ş.		PULSE
MATERIAL	DIAMETER			CESS SELECTOR
.100" THICKNES		T OW	120	60
ALUMINUM ALLO	5556 ALUM. AL Y .035" DIAMETE			x
ALOMINUM ALLO.	I CCU. I	N.		
SHIE	LD GAS		FLOW	
75%HE/25%AR	X		40 CFF	
	SELECTOR	CLITTCUE	<u>c</u>	
EXT	RA LOW	SWLICHE		MAL.
			1101	
		STA	BILITY	- HIGH
		ENE	RGIZER	- OFF
		1		
WELDING				
VOLTAGE				•
<u> </u>	15			
WELDING CURRENT				•
AMPS	50			
POSITION			•	
	VERTICAL-UP			
VOLTAGE	BACKGROU	ND	1	PEAK
SETTING	3.5		1	6.0
	3.3			
WIRE SPEED-IPM		•		IOMETER
SPEED-IPM	245		SETTIN	G 55
TRAVEL				
SPEED-IPM	15.8			-
	13.8	:		
MTC	- 2000 - FEEDER			
MTG	G - 4001 - AIR-COO	LED GUN		•
			•	
j				

BASE	1	E TYPE &			PUI			
MATERIAL		AMETER		120		SELECTOR		
.100" THICKNE	3		.077	120		60		
5086 H-32		LUM. ALI				x		
ALUMINUM ALLO	Y 1 U35"	DIAMETEI						
.1	LD GAS		FLOW RATE					
75%HE/25%AR	X			40 CF	H			
		LECTOR S	WITCHES	3				
EXT	RA LOW			NO	RMAL			
		,						
mil				RGIZER				
السلم ا			SIA	BILIZE	r – t	TTGU		
		•						
			-					
WELDING								
VOLTAGE	· 16.9				-			
WELDING	10.9					•		
CURRENT								
AMPS	56							
<u>.</u>								
POSITION				•				
	VERTICA	AL-UP		1				
VOLTAGE	Ba	ACKGROUN	TD .	j	PEA	K		
SETTING		4.0				5.25		
77770	·							
WIRE SPEED-IPM		_		POTEN:				
SPEED-LFM	245	·		SETTI	NG	55		
TRAVEL						•		
SPEED-IPM	18				•			
<u></u>	10							
,								
MTG	G - 2000 - E G - 4001 - A	LEDER ATR-COOT	ED CIM					
•) AMP.							
1								
•								

BASE	WIRE TYPE				SE SELECTOR
MATERIAL .100" THICKNES	DIAMETER		120		60
5086 H-32	5556 ALUM. A	YO.T.TA	120		00
ALUMINUM ALLOY					X
AUGUILINGII AUGU					
	D GAS			RAT	Ē
75%HE/25%AR	X		40 CF	H	
		·			
		R SWITCHE			
EXT	RA LOW	Ì	NO:	RMAL	
			D.G.T.E.D.D.		
		•	RGIZER		
الله	لمسار لسا	SIA	BILIZE	K – 1	ITGU
				•	
			=	_	
WELDING					
VOLTAGE	18.8			•	
WELDING	10.0				•
CURRENT					
AMPS	53				
POSITION	TODOTOAT IID				
	VERTICAL-UP				
VOLTAGE	BACKGRO	OUND		PEA	K.
SETTING		4.35-4.5	ì		4.8-5.0
WIRE SPEED-IPM		•	POTEN		•
SEED-IEM	245	• .	SETTI	NG ———	55
TRAVEL					
SPEED-IPM	18.3	_			
	TO 9 2	· · · · · · · · · · · · · · · · · · ·			
Mile	- 2000 - FEEDER				
1	- 2000 - FEEDER - 4001 - AIR-CO				•
	AMP.	CLLD GOIL			
		•			
			•		
					•

BASE	WIRE TYPE	٤. &		1			
MATERIAL	DIAMETER			CESS	SELECTOR		
.100" THICKNES			120		60		
5086 H-32	5356 ALUMINU	M ALLOY	1		X		
ALUMINUM ALLOY			 				
1							
SHIE	LD GAS		FLOW	RATE	<u> </u>		
75%HE/25%AR	X		40 CFF	I			
	322 7 07 0		-				
Ever	RA LOW	R SWITCHE		MAL			
EAL.	RA LUW		NOR	WIAL			
		START	LIZER -	. TOU			
		T	IIZER -				
				~- 1			
		1					
			<u> </u>				
WELDING							
VOLTAGE	16.5			•			
WELDING			· · · · · · · · · · · · · · · · · · ·		•		
CURRENT	60						
AMPS	60						
			-				
POSITION	MECHANIZED FLA	Т	•				
VOLTAGE	BACKGR		İ	PEA	K		
SETTING	4.0		1	6	•5		
WIRE			DOMESTI	TOVO	wed		
SPEED-IPM	150	•	POTENT				
	200		DELLIN	3	0		
TRAVEL					•		
SPEED-IPM	22				,		
		 	AUTO				
MTG	- 2000 - FEEDER	2	BUG-		K. 25		
l .	- 4001 - AIR-CO						
	AMP.						
B.77							

						Direct (· · · · · · · · · · · · · · · · · · ·
BASE	1		TYPE &	į		PULS	
MATERIAL		DIA	METER			CESS	SELECTOR
.125" THICKN	ESS				120		60
5083 H-323	- 1	5556 AL	UM. ALI	LOY		Í	**
ALUMINUM ALI	OY I		IAMETER				X
ALIOTIZATORI REGI						•	
						•	
SHI	ELD G	AS			FLOW	RATE	
75%HE/25%AF					40 CFI	I	
1 3/1103/ 23/1111	- 1.4						
		CET	ECTOR 9	SWITCHES			
EX	TRA I		incross .	I		RMAL	
F-2	TIKH I	JOW			HOI	WIAL	
		• •					7 .017
		-		1	BILIZE		
لــا۔ ا		لــا		ENE	RGIZER	- OF	F.
				1			
WELDING	1						
VOLTAGE	1	.00				•	
		20.2					
WELDING	1						
CURRENT	1						
AMPS		68					
·							
POSITIO	N	TEDET C	מוז דו		•		
		VERTICA	TI-OF				
VOLTAGI	2	R.A	CKGROU	ND	1	PEA	ĸ
SETTING	•	J 2.					
SEITIM	7		4.75				5.5
WIRE	- 1				POTEN	rTOME:	TER
SPEED-IPM	- 1		•		SETTI		
Di IIID-III		350			DELLI		65
TRAVEL	1						
SPEED-IPM						•	
JEELD-LEE		15.8		<u> </u>			
1	mg -	2000 - F	EEDER				•
		4001 - 4		LED GIN			
	400 A1						
1	TOO PA						
1							
1 .							

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BASE	WIRE TYPE	&			LSE
MATERIAL 125" THICKNE	SS DIAMETER		1. P		S SELECTOR
5083 H-323	5556 ALUM. AI	LLOY	120	'	60
ALUMINUM ALLO			j	1	X
			F		
	LD GAS		FLO	I RAT	<u> </u>
75%HE/25%AR	X		40 CI	H	
	SELECTOR	SWITCHE	S		
EXT	RA LOW		NO	RMAL	
İ		CTA	מינים די	'D *'	TOTA
			BILIZE RGIZER		
			~	. 01	•
<u> </u>		1	·	 	
	•				
WELDING					
VOLTAGE	21.7			•	
WELDING				 -	•
CURRENT			•		
AMPS	68				
POSITION					
10011101	VERTICAL-UP		•		
VOLTAGE	<u> </u>	ND.			
SETTING	BACKGROU			PEA	K
	5.	0	,		6.0
WIRE			POTEN:	TIOME	TER
SPEED-IPM	350		SETTI	NG.	-65
TRAVEL					
SPEED-IPM	18.4		•	•	•
	TO • 4		· · · · · · · · · · · · · · · · · · ·		
MTG	- 2000 - FEEDER G - 4001 - AIR-COO D AMP.	LED GUN			•
					1
					j
	•				1
					i

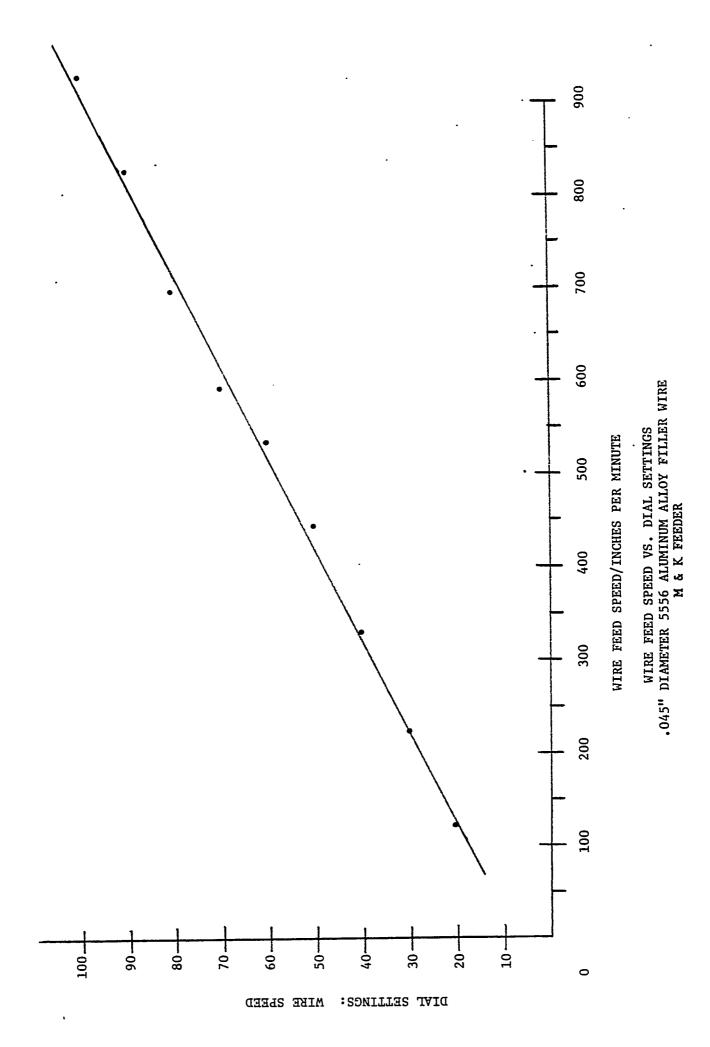
BASE	WIRE TYPE &		PULSE .			
MATERIAL	DIAMETER		PROCESS SELECT			
.125" THICKNES 5083 H-323	5556 ALUM. AI		120_	- 	60 X	
ALUMINUM ALLOY	1 .035 DIAMEL	<u> </u>				
			TT 017	TO LOTT		
SHIEL			FLOW RATE 40 CFH			
75%HE/25%AR	X		40 GF1			
	SELECTOR	SWITCHES				
EXTR	A LOW		NORMAL			
		7	BILIZER			
	-, 	ENE	ENERGIZER - OFF			
	┙ ┡┙					
						
WELDING						
VOLTAGE	20.5			-		
WELDING					· · · · · · · · · · · · · · · · · · ·	
CURRENT			•			
AMPS	65					
DOCTOR						
POSITION	ITION HORIZONTAL					
VOLTAGE	BACKGRO	UND	1	PEA		
SETTING		.75-5			5.5	
WIRE		•	POTEN	TIOME	TER	
SPEED-IPM	350	SETTING			65	
			I		ری	
TRAVEL				•	•	
SPEED-IPM	18					
	- 2000 - FEEDER					
MTG - 4001 - AIR-COOLED GUN						
400 AMP.						
		•				

BASE	WIRE TYPE &		PULSE			
MATERIAL.	DIAMETER			CESS SELE		
.125" THICKNES	h ,		120	60		
5083 H-323 ALUMINUM_ALLOY	5356 ALUMINUM	ALLUY		x		
ALUMINUM ALLUY						
			•			
	LD GAS		FLOW RATE			
75%HE/25%AR	X		40 CFH			
	SELECTOR	CIJT TO CUE	<u> </u>			
EXT	RA LOW	NORMAL				
	Mr Mon		NORMAL			
		ENERG	IZER -	OFF		
		STABI	LIZER- :	LOW.		
WELDING VOLTAGE	70.6			•		
	18.6					
WELDING				•		
CURRENT AMPS	68					
AFIFS			•			
POSITION			•			
	MECHANIZED FLAT					
VOLTAGE	BACKGROU	NTO	1	PEAK		
SETTING			6.75			
	4.5		 	0./3		
WIRE				IOMETER		
SPEED-IPM	175		SETTIN	G 39		
TRAVEL						
SPEED-IPM	16.2			•		
	10.4					
			AUTO			
MTG - 2000 - FEEDER BUG-O G						
MTG - 4001 - AIR-COOLED GUN						
400 AMP.						
C.67						

BASE	WIRE TYPE &		PULSE PROCESS SELECTOR				
MATERIAL.	DIAMETER		120	60			
.5" THICKNESS 5086 H-116 ALUMINUM ALLOY	3/64" DIAMETER 5356 ALUMINUM ALLOY			X	- 00		
	"J" GROOVE						
SHIEL	D GAS			FLOW RAT	le .		
75%HE/25%AR	X			40 CFH			
		SELECTOR	SWITCHE				
EXT	MOL AS			NORMAI		ļ	
l			I	GIZER - LO			
l			STAB	SILIZER - (Jrr	l	
} -1						I	
			1				
				- <u></u>			
WELDING VOLTAGE	1 21.3	2 25.8	3 27.3	4 23	5 - 23		
WELDING CURRENT AMPS	1 120	2 155	3 176	4 116	5 117		
POSITION	FLAT						
VOLTAGE SETTING	1 5	2 BACKGROU 5.5	ND ₃ 4	5 Pi 25 5.255.	EAK 1 2 3 5 6.25 7	4 5 6.56.5	
WIRE SPEED-IPM	1 270 3		4 5 70 2 65	POTENTION SETTING 6	METER 2 3 0 70 75	4 60 58	
TRAVEL SPEED-IPM	1 16.2	2 12.7	3 15	4 15.6	5 16.2		
MTG - 2000 - FEEDER MTG - 4001 - AIR-COOLED GUN 400 AMP. 5 PASS WELD							

BASE	1 •	WIRE TYPE &		PULSE PROCESS SELECTOR		
MATERIAL .5" THICKNESS		DIAMETER		60		
5083 H-321		3/64" DIAMETER 5356 ALUMINUM ALLOY				
ALUMINUM ALLOY	1 '		X			
пдп	GROOVE		•			
. I	D GAS		FLOW RAI	E		
75%HE/25%AR	X		40 CFH			
		SWITCHE				
EXT	RA LOW		NORMAL			
		STAB	STABILIZER - LOW			
		3	GIZER - OF			
		 · · · · · · · · · · · · · · · · · ·	 			
WELDING	1 2	3	4			
VOLTAGE	24.5 29.8	30.2	30.4	•		
WELDING	1 2	2	,	•		
CURRENT	1 2 154 180	3 148	4 152			
AMPS	254 200	140	134			
POSITION						
	FLAT					
VOLTAGE	1 2 BACKGRO	UND 3	4 PE	AK		
SETTING	5.5 6.25		$6.5 \frac{1}{7}$	7^{2}_{125} $\frac{3}{7}$ 7^{4}_{125}		
WIRE	1 2 3	4	POTENTION	ETER		
SPEED-IPM	330 475 300		POTENTION SETTING 68	2 3 4 3 75 65 65		
TO ATTET		 	1 00	/ _ 03 03		
TRAVEL SPEED—IPM	1 2	3		•		
	16.8 13.1	21	18.3			
MTG - 2000 - FEEDER						
MTG - 4001 - AIR-COOLED GUN						
400 AMP. 1500"						
4 PASS WELD						
₹3° 17° 2° 2° 2° 2° 2° 2° 2° 2° 2° 2° 2° 2° 2°						

MACHINE SETTINGS FOR GILLILAND CV 600 FI-PA



FILLER WIRE ALLOY

BASE	WIRE TYPE & PULSE		LSE		
MATERIAL	DIAMETER	DIAMETER PROC		ESS SELECTOR	
.063" THICK	.035" DIAMETE	R	120	60	
5086 H-32	5356 ALUMINUM	ALLOY		1	
ALUMINUM ALLOY			<u> </u>	X	
	•	_			
CHIE	D GAS	T	FLOW RA	rr.	
75%HE/25%AR		 	40 CFH		
I JABEL & JABEL	A	 	40 011		
	SELECTOR	SWITCHE	S		
			-		
ARC SUSTAINE	R HIGH 🗖				
•	·				
• •	LOW M	•			
POSITION	**************************************				
TOBLITOR	VERTICAL-UP				
WELDING					
VOLTAGE	18.7	•		-	
WELDING	10.7			•	
CURRENT					
AMPS	39				
CURRENT					
PEAK SETTING			•		
SETTING	225		· · · · · · · · · · · · · · · · · · ·		
nage VOLTAGE		_	•		
BACK SETTING	13		* •	•	
	1.0				
WIRE		•			
SPEED-IPM	170	- 			
TRAVEL					
SPEED-IPM					
	17.1		·		
POTENTIOMETER					
SETTING	60 0000				
WIRE SPEED	,60 TEN TURN				
1					
	AIRCO AHF-NP	-AH 35-C2	2		
1					

MACHINE SETTINGS FOR . MILLER PULSTAR 450

PULSE WIRE TYPE & BASE PROCESS SELECTOR DIAMETER MATERIAL .100" THICK .035" DIAMETER 120 60 5356 ALUMINUM ALLOY 5086 H-32 X ALUMINUM ALLOY FLOW RATE SHIELD GAS 40 CFH 75%HE/25%AR X SELECTOR SWITCHES ARC SUSTAINER HIGH 🗆 LOW POSITION VERTICAL-UP WELDING VOLTAGE 20.4 WELDING CURRENT 58 AMPS PEAK CURRENT SETTING 250 BACK VOLTAGE SETTING 16 WIRE SPEED-IPM 244 TRAVEL SPEED-IPM 17.1 POTENTIOMETER SETTING 1.25 TEN TURN WIRE SPEED AIRCO AHF-NP-AH 35-C2

MACHINE SETTINGS FOR . MILLER PULSTAR 450

PULSE WIRE TYPE & BASE PROCESS SELECTOR DIAMETER MATERIAL 120 60 .125" THICK .035" DIAMETER 5083 H-323 5356 ALUMINUM ALLOY X ALUMINUM ALLOY SHIELD GAS FLOW RATE 75ZHE/25ZAR X 40 CFH SELECTOR SWITCHES ARC SUSTAINER HIGH 🗖 LOW POSITION VERTICAL-UP WELDING VOLTAGE 23.0 WELDING CURRENT AMPS PEAKCURRENT SETTING 250 BACK VOLTAGE SETTING 21 WIRE SPEED-IPM 320 TRAVEL SPEED-IPM 20.5 POTENTIOMETER SETTING 2.0 TEN TURN WIRE SPEED AIRCO AHF-NP-AH 35-C2

MACHINE SETTINGS FOR . MILLER PULSTAR 450

BASE	WIRE TYPE &	1	LSE
MATERIAL	DIAMETER		S SELECTOR
.125" THICK	.035" DIAMETER	120	60
5083 H-323	5356 ALUMINUM		
ALUMTNUM ALL	OY L		X
	_		
SHIEL	D GAS	FLOW RAT	TE.
75%HE/25%AR		40 CF	
, 3,444, 45,444		9617_1.17	<u> </u>
	SELECTOR SWITCH	TES	
		•	
ARC SUSTAINE	R HIGH 🗖		
	LOW III		
POSITION			•
LOSTITON	VERTICAL-UP		
WELDING			
VOLTAGE	21.8		•
WELDING	21.8		
CURRENT			
AMPS	63		
	_03		***
PEAK CURRENT SETTING			
SETTING	300		
TOT TACT			
BACK SETTING	•		
SELLING	18		
WIRE			
SPEED-IPM	270		
	410		,
TRAVEL			•
SPEED-IPM	17.1	<u>. , , , , , , , , , , , , , , , , , , ,</u>	
POTENTIOMETER			
SETTING			
WIRE SPEED	340		
THE OTHER			
ł	16 6 77 60	t t m r o	
1	M & K COBRAM	IATIC	
1			
}			

BASE	WIRE TYPE &	PULSE		
MATERIAL	DIAMETER		S SELECTOR	
.125" THICKNE		120	60	
5083 H-323	3/64" DIAMETER			
ALUMINUM ALLO	Y		X	
	· _			
	20.00	FLOW RAT	*P	
75%HE/25%AR	D GAS	40_C		
/3%HE/23%AR	<u> </u>	40_U	<u> </u>	
	SELECTOR SWITCHES	3		
ARC SUSTAINE	R HIGH 🖼			
	LOW 🗖			
			•	
POSITION	MECHANIZED FLAT			
WELDING				
VOLTAGE			•	
	21.2		<u> </u>	
WELDING			•	
CURRENT	70			
AMPS	70			
₹ CURRENT	•			
E SETTING	250	•		
	230			
ĕ VOLTAGE			•	
∯SETTING	17			
WIRE				
SPEED-IPM	·			
JE BEG-LEM	170	 		
TRAVEL			•	
SPEED-IPM	16.1			
POTENTIOMETER				
SETTING	.70			
		AUTO		
	- •	BUG	-0 G	
C. 68.	AIRCO AHF-NP-AH 35-C2			
C.69				
C. 70				

	ASE	WIRE TYPE &			ILSE SS SELECTOR	
	TERIAL		DIAMETER		120	60
.250	H-116 "THICKNES TNUM ALLOS	SS 5556	" DIAMETER ALUMINUM A		Х	
<u> </u>		•		-		•
	SHIEI	D GAS			FLOW RAT	re
75%	HE/25ZAR				40 CFH	
			"J" GRO	OVE		
			SELECTOR S	WINCHES		
AR	C SUSTAINE	•	igh s	-	•	
POSI	TION	FLAT M	ECHANIZED			•
AOLI	DING LAGE	23	24			•
	DING RENT PS	105	105			•
PEAK	CURRENT SETTING	325	325		•	
BACK	VOLTAGE SETTING	16	16	-	· .	-
	WIRE ED—IPM	355	380			
	ravel Ed—IPM	16	12.2			
SETT	NTIOMETER ING SPEED	1.55	1.7	TEN I	TURN	
	BUG-O	G.5	C.5			
D.25			-	.250	≥ ± 75 ↑	30

BASE		E TYPE				PULSE	· ·
MATERIAL 5083-H 321		LAMETER			120	<u> </u>	ELECTOR 60
.250 Thick		" Dia.		t			
ALU Alloy	5556	ALU A	Lloy		XX		
	•						
SHIEL	LD GAS		Ι	· ·	FLOW F	RATE	
75ZHE/25ZAR X				40	CFH		
	"J	" Groo	ле				
	S	ELECTOR	SW.	TCHES	3		
	. •						
ARC SUSTAINE	R HIG	KK.					·
	LOW						
POSITION	Mechan	ized F	lat				
WELDING VOLTAGE	22.2	23				•	
WELDING CURRENT AMPS	98	118				•	
CURRENT SETTING	300	350					-
VOLTAGE SETTING	16	16	•				
WIRE SPEED—IPM	230	265					
TRAVEL SPEED—IPM	12	16		· ·			•
POTENTIOMETER SETTING	1.5	1.8					
AUTO BUG-0	C.5	G					
AIRCO AHF-NE	?-АН 35-С	2		.250 +		.30 K	

BASE	1	WIRE TYPE &			PULSE
MATERIAL		DIAMETER		120	OCESS SELECTO
5" THICK	1 '	DIAMETE		120	- 00
083 H-321	4	ALUMINUM	I ALLOY	х	_
TIME ALLEY		· · · · · · · · · · · · · · · · · · ·			
	2 010			ET OU	RATE
75ZHE/25ZAR	D GAS				CFH
/ JAMES / BJALLET	A				X
		"J" GR			
		SELECTOR	SWITCH	ES	
* •• •				•	
ARC SUSTAINE	R HI	GH. 📕			
•	•				
<u>-</u> .	LO	W 🗖			
POSITION					•
	FLAT -	MULTIPLE	PASS		
WELDING					
VOLTAGE	24.5	28	28	25.5	25.5
WELDING					
CURRENT	1/0	4 50			
AMPS	140	150	150	132	132
PEAK CURRENT				_	
PEAK SETTING	350	400	400	<u>.350</u>	350
VOLTAGE					
BACK SETTING	21	24	24	22	22
	_ 				
WIRE SPEED—IPM			• .		
U. EDD-LEFT	380	420	420	360	360
TRAVEL					•
SPEED—IPM	14.1	11	11	·16	16
OTENTIOMETER					TEN TURN
SETTING		0 4		0.5	
VIRE SPEED	2.7	3.1	3.1	2.5	2.5
					[,52"]
	AIRCO A	HF-NP-AH	35-C2	\leq	
					8-

BASE	WIRE TYPE &			PUL		
MATERIAL		DIAMETER			SELECTOR	
.5" THICK		DIAMETER	_	120	60	
5083 H-321	1	ALUMINUM A	ALLOY	1		
ALUMINUM ALLO) <u>Y</u>			X		
			-			
SHIEI	D GAS			FLOW RATE	·	
75ZHE/25ZAR)				40 CFH		
		!! -!! - an a arm	-			
		"J" GROOVI				
		SELECTOR S	WEIGHES			
· ·	•			•		
ARC SUSTAINE	R HI	丑 暮				
•	•					
	LOV	7 🗖				
POSITION				•		
POSITION	FLAT -	MULTIPLE I	PASS			
WELDING						
VOLTAGE	24.5	20 =	25 /	25.2		
WELDING	24.5	28.5	25.4	25.2	•	
CURRENT						
AMPS	140	150	140	142		
PEAK SETTING						
SELLING	350	400_	350	350		
VOLTAGE						
BACK SETTING	21	24	22	22		
	44 - L	<u> </u>	44	<u></u>		
WIRE						
SPEED—IPM	380	450	360	360		
TRAVEL					•	
SPEED-IPM	14.1	11 5	16	. 10		
	T4.T	11.5	<u> 16 · </u>	16		
POTENTIOMETER				TEN	TURN	
SETTING	2.7	3.25	2.5			
WIRE SPEED						
					1.52"	
BUGO SETTING	E.5	G.5	G.25	G.25	< >	
					1	
				_	TEST -	3
	AIRCO .	AHF-NP-AH	35-C2	2	- (2)	<u> </u>

MACHINE SETTINGS FOR MILLER PULSTAR 450 MECHANIZED

BASE		WIRE TY			ספ	PUI	LSE S SELECT()R
MATERIAL FOR THE CHAPTER	20 27	DIAMET			120	1	60	- 4.V
.500" THICKNES		64" DIAM 56 ALUMI		$_{\text{TOV}}$	140			
5083 H-321	1	OO ALUMI	NUM AL	LUI	X	- 1		
ALUMINUM ALLO	<u> </u>					+		
CHITTE	D GAS				मा तथ	RAT	R	
75%HE/25%AR						CFH		
IJANE ZJANE	<u> </u>	11 -	" GROO	TTE				
			TOR SWI		3			
		JELEC	LOIK DWI	<u>. Critici</u>	·			
ARC SUSTAINE	ik .	HIGH KK					•	
	· •	LOW 🗖						
POSITION	МЕСНА	NIZED FI	LAT					
WELDING								
WELDING VOLTAGE							•	
	25	28	28					
WELDING							-	
CURRENT	750	1.00	157					
AMPS	150	160	157					
PEAK CURRENT								
SETTING	350	400	400		•			
								
BACK COUNTY	l		•			٠.,		
SETTING	22	25	25					
WIRE								
SPEED-IPM	375	400	390					
	3/3	400	290		 			
TRAVEL							•	
SPEED-IPM	14	11.5	11.5					
POTENTIOMETER SETTING								
SETTING	2.9	3.1	3.0	TEN	TIIRN			
ATTMO	12.7							
AUTO	 	C E	C E		1.		52	
BUG-O	E.5	C.5	C.5		→		المعرا	
					.50"	\leq	The state of the s	
AHF NP	AH 35-	-C2						
I.10					T			

WELDING PROCEDURE SPECIFICATION (GUIDE)

This section contains a general welding procedure specification covering out-of-position, one-side, full penetration, manual pulse gas metal arc butt welding of 5000 series aluminum alloy sheet and plate for marine applications. This specification is intended to be used as a guide only.

Also, one page type welding procedure specifications covering each specific test condition and material thickness (.063" - .500") are included.

WELDING PROCEDURE SPECIFICATION (GUIDE)

ALUMINUM WELDING

OUT-OF-POSITION WELDING OF 5000 SERIES ALUMINUM ALLOYS USING GMAW POWER SOURCES

1. SCOPE

This welding procedure covers the requirements for out-of-position, one-side, full penetration, manual pulse gas metal arc butt welding of the 5000 series aluminum alloys. This procedure is applicable to material thicknesses of .063 inch to .500 inch.

2. TABLE OF CONTENTS

- 1. Scope
- 2. Table of Contents
- 3. References
- 4. Material Control
 - 4.1 Base Material
 - 4.2 Filler Metals
- 5. Shielding Gases
- 6. Electrical Characteristics
- 7. Position of Welding
- 8. Facilities Control
- Procedure Qualification & Welder Performance Qualification
- 10. Manufacturing Control
 - 10.1 Joint Design and Tolerance
 - 10.2 Material Preparation
 - 10.3 Weld Joint Fit-Up
 - 10.4 Preheat and Interpass Temperatures
 - 10.5 Tack Welding
 - 10.6 Welding Techniques
 - 10.7 Repair Welds
 - 10.8 Post-Weld Heat Treatment
 - 10.9 Peening
- 11. Quality Assurance

3. REFERENCES

- 3.1 NAVSHIPS 0900-000-1000 with 0900-000-1001; Fabrication, Welding and Inspection of Ships' Hulls. (June 1969).
- 3.2 NAVSHIPS 0900-003-8000; Surface Inspection Acceptance Standards (Sept. 1967).
- 3.3 MIL-STD-0022B (SHIPS); Military Standard Welded Joint Design (May 1969).
- 3.4 MIL-STD-248C; Welding and Brazing Procedure and Performance Qualification (Oct. 1973).
- 3.5 MIL-STD-271E; Nondestructive Testing Requirements for Metals.

4. MATERIAL CONTROL

4.1 Base Material

The base material shall comply with one of the following specifications:

MATERIAL	ALUMINUM ALLOY	
SPECIFICATION	COMPOSITION	TYPE OF MATERIAL
QQ-A-250/6	5083	Plate & Sheet
QQ-A-250/19	5086	Plate & Sheet
QQ-A-250/8	5052	Plate & Sheet
QQ-A-250/20	5456	Plate & Sheet
QQ-A-250/10	5454	Plate & Sheet
QQ-A-225/7	5052	Bar, Rod & Wire
QQ-A-200/7	5456	Bar, Rod, Shapes, Tube, Wire
QQ-A-200/6	5454	Bar, Rod, Shapes, Tube, Wire
QQ-A-200/5	5086	Bar, Rod, Shapes, Tube, Wire
QQ-A-200/4	5083	Bar, Rod, Shapes, Tube, Wire

4.2 Filler Metals

Filler wire alloys for welding aluminum shall be in accordance with the following chart:

Base Alloy	5052	5083	5086	5454	5456
5052	5356				
5083	5356	5356			
5086	5356	5356	5356		
5454	5356	5356	5356	5556	
5456	5356	5356	5356	5556	5556

Filler metals shall conform to AWS A5.10-80, Aluminum and Aluminum Alloy Bare Welding Rods & Electrodes.

Filler metals shall be protected from contamination at all times and shall be stored in a warm dry area.

5. SHIELDING GASES

GASES	SPECIFICATION OR SOURCE		
ARGON	MIL-A-18455		
HELIUM	FEDERAL SPECIFICATION BB-H-1168, GRADE A		
75% HELIUM/25% ARGON	LINDE DIVISION UNION CARBIDE AIR REDUCTION OR EQUIVALENT		

6. <u>ELECTRICAL CHARACTERISTICS</u>

The current used for the GMAW process shall be direct current, reverse polarity.

7. POSITION OF WELDING

The base material may be welded in all position (flat, verticalup, horizontal and overhead) using appropriate diameter filler wire and current settings. Where practicable, the weldments shall be positioned for flat (downhand) welding.

8. FACILITIES CONTROL

The welding equipment shall be such that the weld quality requirements of this specification can be met with reliability and consistency.

9. PROCEDURE QUALIFICATION & WELDER PERFORMANCE QUALIFICATION

Procedure qualification and welder performance qualification shall be per the requirements of MIL-STD-248c.

10. MANUFACTURING CONTROL

10.1 <u>Joint Design and Tolerance</u>

Unless otherwise stated on the plan, weld joint designs and tolerances shall be in accordance with this specification. See Sketch.

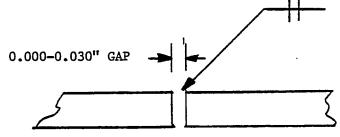
10.2 Material Preparation

Weld joint edges may be prepared by mechanical processes such as machining, filing, routing, grinding, chipping. Prior to welding, surface oxide films on the areas to be welded shall be removed by using a clean stainless steel wire brush.

Brushes may be either manual or power driven. Bristle diameters of the stainless steel wire brushes shall be .010 to .015 inch in diameter. Welding on the cleaned weld joint surfaces shall he done within 8 hours if feasible.

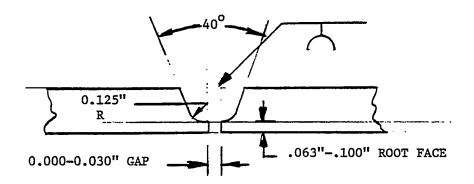
SQUARE BUTT JOINT

PLATES FORMING BUTTS WITH NO BACKING MEMBER SHALL BE FITTED METAL-TO-METAL. PLATES .125" AND THINNER SHALL BE CUT SQUARE . MAXIMUM ALLOWABLE GAP SHALL BE 0.030 INCH.



"J" GROOVE JOINTS

PLATES FORMING BUTTS WITH NO BACKING MEMBER SHALL BE FITTED METAL-TO-METAL. PLATES OVER .125" THICK SHALL BE MACHINED WITH A "J" GROOVE WITH AN ANGLE OF 20° AND 0.100 INCH MAXIMUM ROOT FACE (LAND).



NOTE: SEE SECTION 10.1

WELD JOINT DESIGNS FOR
ONE-SIDE, OUT-OF-POSITION, FULL PENETRATION
MANUAL PULSE GAS METAL ARC BUTT WELDING
OF

5000 SERIES ALUMINUM ALLOY SHEETS AND PLATE

10. MANUFACTURING CONTROL (continued)

10.2 <u>Material Preparation</u> (continued)

The weld joint areas and surfaces on which welds are to be deposited shall be free of grease, oil, rust, slag, water, paint or any other harmful matter.

Build up by welding on the weld joint surfaces to correct oversize root openings or errors in joint preparation shall not exceed 3/8 inch on each joint member. The areas built up by welding shall be ground smooth and faired smoothly into the adjacent material thickness.

Weld joint edges shall be free of laminations and sharp notches which will interfere with welding.

10.3 Weld Joint Fit-Up

Unless otherwise stated on the plans, the weld joint fit-up shall meet the requirements of this specification.

Fit-up shall be metal-to-metal or range from .000 to .030 inch.

10.4 Preheat and Interpass Temperatures

In fabricating heavy weldments, a temperature of at least 60°F in the weldment shall be obtained and maintained until all welding has been completed. Sufficient preheat shall be used to remove moisture. Preheat temperature shall not exceed 300°F, as indicated by approved temperature indicating devices.

10.5 Tack Welding

All tack welding shall be done by personnel qualified per MIL-STD-248C.

Tack welds shall be made with the same type of electrode to be used in the final weld.

Tack welds shall be kept as small as practicable or the excess weld reinforcement shall be chiseled to a size small enough so that they can be absorbed into the final weld. Cracked tack welds and those which are unsuitable to incorporate into the final weld shall be removed.

10.6 Welding Techniques

Stringer weld bead passes shall be utilized for all root weld bead deposits so that one-side, full penetration welds may be attained.

Weld machine settings shall be approximately as shown in the chart below:

PROCESS	WIRE DIAMETER	OPERATING CURRENT RANGE (AMPs)	OPERATING VOLTAGE RANGE	SHIELDING GAS
Manual	.030	25-90	15-20	Argon or
Pulse	.035	30-100	16-20	75%He/25%Ar
GM4AW	3/64	40-150	17-23	
	1/16	45-300	17-28	

In multiple pass welds, each pass shall be wire brushed before depositing subsequent passes. Weld penetration in square groove and "J" joints welded from one-side shall be complete as evidenced by a weld bead and the absence of a joint line on the side opposite that from which the weld was completed. The roots of weld joints must have complete penetration. The weld root area shall be visually examined for defects and weld deposit penetration depth/width consistency.

10.7 Repair Welds

Repair welding shall be limited to those locations which cannot be corrected by grinding. Repair welds shall be made to the same standards as the original work.

Grinding of any defects shall produce a smooth blending of the weld into the surrounding surface of the base material.

Undercut in excess of 10% of the thinner member, whichever is less shall be repaired. Excessive undercut may be repaired by welding or grinding. The repair of undercut by welding shall be accomplished by depositing a weld bead in the undercut area which will fair into the existing weld.

10. MANUFACTURING CONTROLS (continued)

10.7 Repair Welds (continued)

Unless otherwise stated on the plans (drawing), weld reinforcement shall be a minimum weld penetration of 100% and without evidence of a joint line.

Maximum weld reinforcement shall be 3/32 inch.

Excessively convex weld bead configurations are to be ground and faired smoothly into adjacent metal plates/sheets.

Repair welds shall not be flushed except in areas where appearance requires removal, such as the outside of the shell plating and exposed structure in quarters.

10.8 Post-Weld Heat Treatment (Stress Relief)

Unless otherwise stated on the plans or applicable specifications, no post-weld heat treatment is required.

10.9 Peening

Peening of aluminum welds shall not be done on the first and last weld passes.

11. QUALITY ASSURANCE

Quality Assurance shall ensure that all the requirements of this specification are met.

		T		
PACIFIC	SHIPYAR	08 CO	RPORATIO	N

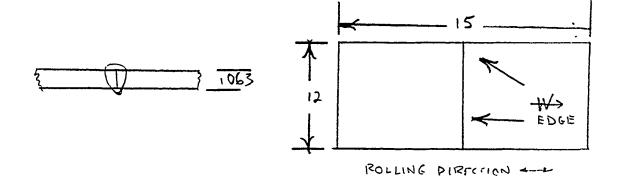
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Pacifi	<u>පු නිර්</u>		ards c			WELDING PR	OCEDURE	ISSUED:	
1	حطد					SPECIFICATION			—
SEA	TTLE	DIVIS	SION					PAGE:	
DESCRIPT									_
		ELDI	NG: OUT-O	F-POSITIO	ON FULL P	ENETRATION	MANUAL	GAS METAL ARC BUTT	
WELDI	NG OF	5000	O SERIES A	LUMINUM	ALLOY SHE	ET & PLATE			
WELDER	MIL	-STD-	-248C			PROCEDURE		STD-248C;MIL-STD-278D	
QUALIF.							. LNAVSH	IIPS 0900-000-1000/1	
BASE						PROCESS:			
METALS_		63"	5086 нз2	00-A-1	50/7			FIDING (GMAW) SHORT ARC	_
SPEC. TY		ALIC	A5.10-80	PD5556		POWER SOUR	DC RP	EL/TYPE AIRCO PULSE ARC 350	
FILLER N		AWD	AD-10-60	<u> </u>		FLUX; SPEC/		PE. MY	
POSITION WELD	N OF	VER	TICAL-UP					PE 75%HE/25%AR 40 CFH	_
JOINT		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	I I OI III OI			CHO L LOR	18-11-1-1	TORCH TYPE BINZEL	
PREPARAT	TTON	REM	OVE SHEAR	OR SAW MA	ARKS FROM	FAYING SU	RFACE	CUP SIZE 3/4 INCH ORIFICE	₹
& SIDE		<u></u>							
NUMBER		BY :	SCRAPING.	FILING O	ROUTING	BOTH SIDE	s		
INTERPAS	SS								
CLEANING	-	STA	INLESS STE	EL WIRE	BRUSHING				_
REPAIRS									
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POSTHEAT		NA				ELECTRODE	IWPS	4003	
TEMPERA	LUKE	INA		<i></i>		ICONTROL I			_
HEAT	.IT	NA							
TREATME! WELD	A)	1112				· · · · · · · · · · · · · · · · · · ·			
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						NETRATION PET & PLATE	MANUAL GAS	METAL ARC BUTT		
WELDER			-248C	HOMENIA.		PROCEDURE	MIL-STD-	-248C;MIL-STD-278D		
QUALIF.							NAVSHIPS	0900-000-1000/1		
BASE METALS	.063	" 508	36 H-32 QQ	A150/7		PROCESS: GAS METAL	L ARC WELL	OING SHORT ARC		
SPEC. TYP	E							TYPE AIRCO PULSE ARC 350		
FILLER ME		AWS	A5.10-80	ER5356		POLARITY]				
POSITION	OF				ļ	FLUX; SPEC/				
WELD		VER'	FICAL-UP			GAS: FLOW_		75%HE/25%AR 40 CFH		
JOINT								FORCH TYPE BINZEL		
PREPARATI	ON	REMO	OVE SHEAR	OR SAW MA	RKS FROM	FAYING SU	RFACE C	CUP SIZE 3/4 INCH ORIFICE		
& SIDE	i									
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ALUMI OF 50			NG; OUT-O: ALUMINUM			PLATE			METAL ARC BUTT WELDING
WELDER QUALIF.	MIL	-STD	-248C			QU			248C;MIL-STD-278D
BASE METALS	.06	3" 50	086 H-32 Q	Q-A-150/7			OCESS: SAS METAL	ARC WELD	ING (GMAW) SHORT ARC
SPEC. TY	PE.								YPE AIRCO PHILSE ARC 350
FILLER M		AWS	A5.10-80	ER5556			LARITY D		
POSITION	OF							IZE/TYPE:	
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JOINT		DEN	OTTE CITEAR	OD CATT MA	חזצפ	777 CM 774	WING CITE		ORCH TYPE BINZEL UP SIZE 3/4 INCH ORIFICE
PREPARAT	TON	REM	OVE SHEAR	OR SAW MA	KKS	FRUM FA	LIING SUK	FACE IC	OF SIZE 3/4 INCH ORIFICE
& SIDE		DV.	CODADTMO T	TT TMC OD	חוזים	ידאיר דיי	מתדם שי		
NUMBER		DI	SCRAPING F	LLING OR	KUUT	TIME BOL	п 210к2		
INTERPAS CLEANING		STA	INLESS STE	EL WTRE E	RUSH	TNG	· · · · · · · · · · · · · · · · · · ·		
REPAIRS		REP	AIR WELDS			TO THE	SAME ST	ANDARDS AS	THE ORIGINAL WORK
PREHEAT		AMB:	IENT	INTERPAS TEMPERAT					
POSTHEAT		1					ECTRODE	TWPS 400	3
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TECHNIOL			J STRINGER				LAGTECA		
TRAVEL		LER	****	ARC	İ		NOTES:		
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APPROVALS: J. H. M. t.

J.C. Johnston

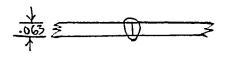
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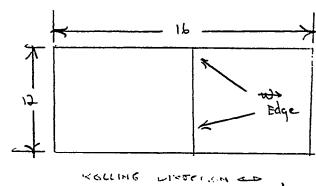
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ŀ	WELDER		-STD-2				PROCEDUR		MIL-STD-	248C;MIL-	STD-278	D .
ļ	QUALIF.							TD.	NAVSHIPS	0900-000	<u>-1000/1</u>	
I	BASE	0 0	63 " 50	186 U_32	QQ-A-1:	50/7	PROCESS:	AT.	ADO INTER		G1707F	170
ŀ	METALS		03 30	700 n-32	. <u> </u>	70//				NG (GMAW)		ARC
ŀ	SPEC. TYP		AWS A	15.10-80	ER5556		POLARITY		DC RP	YPE AIRCO	PA330	
ŀ	POSITION				210000				IZE/TYPE:	NA		~~~~~~~~~~~~
	WELD	O.	OVERH	ŒΑD					ATE/TYPE		75%HE/2	25%AR
ľ	JOINT		1							ORCH TYPE		
l	PREPARATI	NOI	REMOV	E SHEAR	OR SAW MA	ARKS FROM	FAYING S	SURI	FACE C			CH ORIFICE
l	& SIDE											
ŀ	NUMBER	<u>.</u>	BY SC	RAPING,	FILING, C	OR ROUTIN	G BOTH S	IDES	S	 		
INTERPASS CLEANING STAINLESS STEEL WIRE		י מחדנו זע	מונכונדזוכו									
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	REPAIRS		REPAI	R WELDS	SHALL BE	MADE TO	THE SAME	STA	ANDARDS A	S THE ORI	GINAL W	JORK
ľ	PREHEAT		1		INTERPAS							
ļ.			AMBIE	NT	TEMPERAT			,				
	POSTHEAT						ELECTROD	Εļ	TWPS 400	3		
ŀ	TEMPERATU	JRE	NA				CONTROL					
l	HEAT TREATMENT	_	NA									
ľ	WELD	L	NA.	 				-				
l	TECHNIQUE	=	GMAW	STRINGER	BEAD							
ľ	TRAVEL		LER		ARC		NOTES	:				
	SPEED	MET	AL A	MPERAGE	VOLTAGE							
	(I.P.M.)	SIZ		RANGE	RANGE	POSITION	4					
	20	3/6	4"	50	15.5	OVERHEAD						
							 					
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JOINT DESIGN: BIS.1/MIL. STD. 22

THICK RANGE QUAL.

SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE





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PACIFIC	SHIPYARDS	CORPORATION
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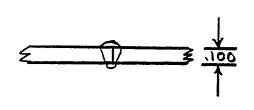
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DESCRIPT	TON									
ALUMINUM WELDING; OUT-OF-POSITION PENETRATION MANUAL GAS METAL ARC BUTT WELDING OF 5000 SERIES ALUMINUM ALLOY SHEET & PLATE										
WELDER			-248C	1011111011	<u></u>	PRO	CEDURE		-248C;MIL-STD-278D	
QUALIF.				,			LIF.STD. CESS:	INAVSHIP	5 0900-000-1000/1	
BASE METALS	0.1	00 "	5086 H-32	00-A-150)/7			ARC WELD	ING (GMAW) PHILSED ARC	
SPEC. TY		<u> </u>				POV	ER SOURCE	E; MODEL/	TYPE AIRCO PA3A	
FILLER M	ETAL	AWS	A5.10-80	ER5356			ARITY D			
POSITION	OF							IZE/TYPE		
WELD		VER	TTCAL-UP			I GAS	S: FLUW N		An CFH 75%HE/25%AR TORCH TYPE BINZEL	
JOINT PREPARAT	ION	REM	OVE SHEAR	OR SAW MA	ARKS FRO	OM FA	YING SUR		CUP SIZE 3/4 INCH ORIFICE	
& SIDE NUMBER		BY :	SCRAPING.	FTT.TNG OF	ROUTT	NG BO	TH SIDES			
INTERPAS	S									
CLEANING		STA	INLESS STE	EL.						
REPAIRS		REP.	AIR WELDS			O THE	SAME ST	'ANDARDS	AS ORIGINAL WORK	
PREHEAT		A367	Trans	INTERPAS		A				
DOCTLIE A T		AMB	IENT	TEMPERAT	UREL N.		ECTRODE	TWPS 40	103	
POSTHEAT TEMPERAT		NA					VTROL			
HEAT	OIN_									
TREATMEN	<u> </u>	NA								
WELD										
TECHNIOL			W STRINGER	BEAD			NOTES:			
TRAVEL SPEED	MET	LER	AMPERAGE	VOLTAGE	•		140125.			
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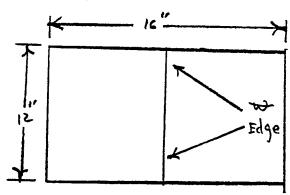
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_	DESCRIPTION									
	OUT-OF-POSOTION, ONE SIDE, FULL PENETRATION MANUAL GAS METAL ARC BUTT									
		W	ELDIN	IG OF ALUM	INUM ALLO	Y SHEETS			RINE APPLICATION	
	WELDER	MIL	-STD-	-248C			PROCEDURE		D-248C;MIL-STD-278D	
_	QUALIF.							. NAVSHI	PS 0900-000-1000/1	
	BASE					Ī	PROCESS:	ለው <i>ሮ ኒ</i> መር ነ	DING (GMAW) PULSE ARC	
	METALS		90	086 н32	00-A-150	1/7			/TYPE PA 3A AIRCO	
	SPEC. TY		AWS	A5.10-80	ER 5356		POLARITY DO	CE;MODEL	/ TIPE TA JA AIRCO	
-	FILLER N POSITION			120 00			FLUX; SPEC/		F· NA	
	WELD _	I OF	HOR	ZONTAL					E 40 CFH 75%HE/25%AR	
_	JOINT							<u> </u>	TORCH TYPE NP C2	
	PREPARAT	TION	REMO	OVE SHEAR	OR SAW MA	RKS FROM	FAYING SU	RFACE	CUP SIZE 3/4 INCH ORIFICE	
	& SIDE									
	NUMBER		BY S	CRAPING.	FILING OR	ROUTING	BOTH SIDE	5		
	INTERPAS	SS								
_	CLEANING	}	STAI	NLESS STE	EL WIRE B	RUSHING	 			
	REPAIRS			TD 1777.00	DD					
REF			REP	REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS ORTGINAL WORK						
	PREHEAT		AMBIENT TEMPERATURE NA							
_	POSTHEAT		ALID	-121/(L	HEMELNAI	ONL) NA	ELECTRODE	TWPS 4	.003	
	TEMPERAT		NA CONTROL							
_	HEAT				•					
	TREATMEN	л	NA							
	WELD									
_	TECHNIO		GMAV	STRINGE					<u> </u>	
	TRAVEL		LER		ARC		NOTES:			
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SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE





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PACIFIC	SHIPYAR	rds cor	PORATION
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SEATTLE DIVISION						~	SPECIFICATION PAGE:		PAGE:
		1117	TOM						
DESCRIPTION AT JIMENT	NC TWINT	T.DTN	ig: OUT-O	F-POSITIO	N FULL P	ENE	TRATION	MANUAL G	AS METAL ARC BUTT
WELDING	G OF	5000	SERIES A	LUMINUM A	LLOY SHE	ET	& PLATE		
WELDER			-248C			PRO	CEDURE	MIL-STE	0-248C;MIL-STD-278D
QUALIF.								. I NAVSHIE	95 0900-000-1000/1
BASE		 -			17	1	CESS:	ADG ITTE	ING (GMAW) SHORT ARC
METALS		00 " 5	086 H-32	QQ-A-150	1.1				TYPE AIRCO PA 350
SPEC. TYPI		ATJC	A5.10-80	FR 5356			ARITY		THE ALLOW IA JOY
POSITION (AND	W-10-00	<u> </u>		FL	JX:SPEC/	SIZE/TYPE	: NA
WELD	Ŭ.	OVE	RHEAD			GA:	: FLOW	RATE/TYP	40 CFH 75%HF/25%AR
JOINT							VTV0 0111	TLACE	TORCH TYPE BINZEL
PREPARATI	ON	REMO	OVE SHEAR	OR SAW MA	RKS FROM	1 LA	YING SUL	RFACE	CUP SIZE 3/4 INCH ORIFICE
& SIDE		י עם	SCRAPING,	מדד דאור חום	סמוידאות	י אח	ידו פדחדי	3	
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INTERPASS CLEANING)	STA:	INLESS STE	EL WIRE E	RUSHING				
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PREHEAT				INTERPAS					
		'AMB	CENT	TEMPERAT	UREL NA	1=1	ECTRODE	TWPS 4	003
POSTHEAT		NA					NTROL	(11/1)	
TEMPERATU HEAT	KE.	NA				100			
TREATMENT	-	NA_							
WELD									
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TRAVEL	1	LER	****	ARC			NOTES:		
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(I.P.M.)		64"	70	16	OVERHEAD				
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APPROVALS:

James C. Johnston

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ALUMIN								MANUAL GAS	METAL ARC BUTT
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WELDER QUALIF.	MIL	-STD	-248C						0900-000-1000/1
BASE							OCESS:	TIV VIIIC	0200 200 2000/
METALS	0.1	יי 25	5083 H-323	QQ-A-250	/6				NG (GMAW) SHORT ARC
SPEC. TYP	E			_		PO	WER SOUR	CE; MODEL/T	YPE AIRCO PULSE ARC 350
FILLER ME		AWS	A5.10-80 1	ER 5556		_	LARITY	DC RP	
POSITION	OF							SIZE/TYPE:	
WELD		VER:	CICAL-UP			IGA	S: FLOW	RATE/TYPE	40 CFH 75%HE/25%AR
JOINT	·0\/	DEM	OVE SHEAR (OR SAU MA	BKS EBU	ν TrΔ	YTNG SIID		ORCH TYPE BINZEL UP SIZE 3/4 INCH ORIFICE
PREPARATI	ON	KEN	JAE BIERK	JI DAN IIA	ICCO PRO	I L'E	ILING DOIL	TACE 10	OF SIZE 3/4 INGII CRIFICE
& SIDE NUMBER		BY S	CRAPING,	FILING OR	ROUTIN	G BC	TH SIDES		
INTERPASS	:								
CLEANING		STA	INLESS STE	EL WIRE B	RUSHING				
REPAIRS		REP	AIR WELDS			THE	SAME ST	ANDARDS AS	ORTGINAL WORK
PREHEAT	,			INTERPAS					
		AMB.	CENT	ITEMPERAT	UREL NA	le:	ECTRODE	TWPS 400	7
POSTHEAT TEMPERATU	iDE	NA					NTROL	(MC3 700	,
HEAT		N.E.							
TREATMENT	•	NA_							
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TRAVEL	i	LER		ARC			NOTES:		
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ROLLING DIRECTION ---

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PACIFIC	SHIPYAR	109 CO	RPORATION

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	3 911	BB 87		الت	<u></u>	WELDING PROCEDURE SPECIFICATION			ISSUED:
· SEA	TTLE (OIVIS	SION			٥,	LO1) 10r	11 1011	PAGE:
DESCRIPT									
ALUMI	num wi		•					MANUAL GA	S METAL ARC BUTT
			SERIES A	LUMINUM_A	LLOY SHE			WIL CTD	2/2C-MIL STD 272D
WELDER QUALIF.	MIL	-STD-	-248C			QUA			248C;MIL-STD-278D 0900-000-1000/1
BASE		- 11-			1.0	1	ESS:		CHORM ADO
METALS SPEC. TY		2550	083 H-323 (00-A-250	6				NG (CMAW) SHORT ARC YPE AIRCO PULSE ARC 350
FILLER M		AWS	A5.10-80	ER5356			ARITY I		
POSITION						FLU:	X;SPEC/	SIZE/TYPE:	NA
WELD		VER'	TICAL-UP	 		I GAS	FLOW		40 CFH 75%HE/25%AR
JOINT		DEM	NUE CUEAD (OD CALL M	מסער דים (א	A TOAY	TNC CIT		ORCH TYPEBINZEL UP SIZE 3/4 INCH ORIFICE
PREPARAT	ION	REM	OVE SHEAR (JR SAW PL	TONE CARE	I PAI	THE SOL	FACE IC	OP SIZE 3/4 INCH URIFICE
& SIDE NUMBER		BY S	CRAPING,	FILING O	ROUTING	BOT	H SIDES	.	
INTERPAS	S								
CLEANING		STA	INLESS STE	EL WIRE I	RUSHING				
REPAIRS		REP	AIR WELDS	SHALL BE	MADE TO	THE	SAME ST	'ANDARDS_A	S ORTGINAL WORK
PREHEAT				INTERPAS					
		AMB:	CENT	TEMPERA	UREI NA	15.5	CTROPE	TWPS 400	7
POSTHEAT		ATA					CTRODE TROL	1WP5 400	15
TEMPERAT HEAT	UKE	NA				ICON	INVL. I		
TREATMEN	п	NA							
WELD	<u> </u>								
TECHNIOL			V STRINGER						
TRAVEL		LER		ARC		- 1	NOTES:		
SPEED	MET		AMPERAGE	VOLTAGE RANGE	POSITIO	w			
(I.P.M.) 14.1) SIZ 3/6		RANGE 70	17	VERTICAL				
44.7	1 3/6	-			VIICITORI	-			
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JOINT DE	SIGN	B1S.	1/MIL. ST	D. 22				ANGE QUAL	<u> </u>
		SKE	TCH OF WEL	D LOCATIO	ON & TYP:	ICAL	PASS SE	QUENCE	
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PACIFIC	SHIPYARDS	CORPORATION

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PACIFIC SI	IPYARDS C	ORPORA	**-	LDING PR		ISSUED:
				SPECIFIC	ATION	
	DIVISION					PAGE:
DESCRIPTION	TINTNO OUTOE	· ₽₽₽₽₽₽₽₽₽	אמאק נחוא נ	ጥ የተፈተፈረ	MANIIAT. GAS	METAL ARC BUTT
	5000 SERIES AL				THUOSH GAD	IMIAN AND DOLL
	-STD-248C		PR	OCEDURE		248C;MIL-STD-278D 0900-000-1000/1
BASE				OCESS:		
METALS 0.1	25" 5083 H-323	00-A-2				NG (GMAW) SHORT ARC
SPEC. TYPE	ATTO AE 10 00 E	n sees	ļ -	WER SOUR LARITY D		YPEAIRCO PULSE ARC 350
FILLER METAL POSITION OF	AWS A5.10-80 E	K 3336			SIZE/TYPE:	NA
WELD	HORIZONTAL					40 CFH 75%HE/25%AR
JOINT						ORCH TYPE BINZEL
, , _ , , , , , , , , , , , , , , , , , , ,	REMOVE SHEAR C	OR SAW MAI	RKS FROM FA	YING SUR	FACE C	UP SIZE 3/4 INCH ORIFICE
& SIDE	BY SCRAPING. F	לדז דאיר אם	שמויידאיר א	יים כדהבכ	ı	
NUMBER INTERPASS	BI SCRAFING. F	TITING OR	KOUT ING BO	111_311/153	<u> </u>	
CLEANING	STAINLESS STEE	L WIRE B	RUSHING			
REPAIRS	REPAIR WELDS S	HALL BE	MADE TO THE	SAME ST	'ANDARDS, AS	ORTGINAL WORK
PREHEAT	AMBIENT	INTERPAS TEMPERAT				
POSTHEAT	AMBIEN	110 11 014 11	EL	ECTRODE	TWPS 400	3
TEMPERATURE	NA		ICC	NTROL		
HEAT TREATMENT	NA	•				
WELD			<u> </u>			
TECHNIQUE	GMAW STRINGER				<u> </u>	
1	LER	ARC		NOTES:		
SPEED MET	TAL AMPERAGE RANGE	VOLTAGE RANGE	POSITION	ļ		
	64" 85	19.5	HORIZONTAL	1		
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	D10 1/2077	CMD 00		THEOR	DANCE OUA!	
JOINT DESIGN			W 0 TOTO:		RANGE QUAL.	<u> </u>
1	SKETCH OF WEL	D LOCATIO	N & IYPICA	_ PASS St	EQUENCE	P .
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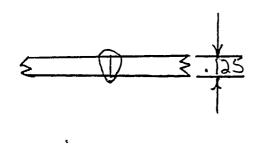
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PACIFIC	SHIPYAR	108 CORP	ORATION
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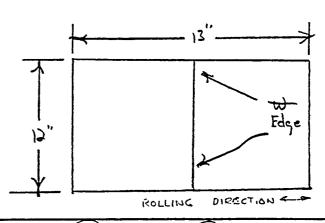
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PAGE: DESCRIPTION ALUMINUM WELDING; OUT-OF-POSITION FULL PENETRATION MANUAL GAS METAL ARC BUTT WELDING OF 5000 SERIES ALUMINUM ALLOY SHEET & PLATE MIL-STD-248C; MIL-STD-278D PROCEDURE WELDER MIL-STD-248C OUALIF.STD. NAVSHIPS 0900-000-1000/1 QUALIF. PROCESS: BASE GAS METAL ARC WELDING (GMAW) SHORT ARC 0.125' 5083 H-323 QQ-A-250/6 METALS POWER SOURCE; MODEL/TYPE AIRCO PULSE ARC 350 SPEC. TYPE POLARITY DC RP AWS A5.10-80 ER 5356 FILLER METAL FLUX; SPEC/SIZE/TYPE: NA POSITION OF GAS: FLOW RATE/TYPE 40 - CFH 5%HE / 25%AR OVERHEAD WELD TORCH TYPE BINZEL TMIOL REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE CUP SIZE 3/4 INCH ORIFICE PREPARATION & SIDE BY SCRAPING, FILING OR ROUTING BOTH SIDES NUMBER **INTERPASS** STATNLESS STEEL WIRE BRUSHING CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS ORIGINAL WORK INTERPASS **PREHEAT** AMBIENT TEMPERATURE NA TWPS 4003 ELECTRODE **POSTHEAT** NA CONTROL TEMPERATURE HEAT TREATMENT NA WELD GMAW STRINGER BEAD TECHNIOUE NOTES: FILLER ARC TRAVEL METAL AMPERAGE **VOLTAGE** SPEED RANGE RANGE POSITION (I.P.M.) SIZE 3/64" **OVERHEAD** 20 105 15

JOINT DESIGN: B1S.1/MIL. STD. 22 THICK RANGE QUAL. SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE





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PACIFIC SHIPYARDS CORPORATION						LDING PRO		E	ISSUED:	
SEA	TTLE	DIVI	SION			•	SPECIFICA	ALTON		PAGE:
DESCRIPT					·····					<u> </u>
										AS METAL ARC BUTT WE APPLICATION
WELDER QUALIF.			-248C			PR	OCEDURE	MIL-	STD-	248C;MIL-STD-278D 0900-000-1000/1
BASE METALS	. 25	o" 5	086 H116 Q	Q-A-250/1	.9					ELDING (GMAW)
SPEC. TY		AW	S A5.10-80	ER 5556			WER SOUR	DC RE		YPE AIRCO PA 350
FILLER M POSITION			3 113 1 10 00	210 3330	· · · · · · · · · · · · · · · · · · ·		UX;SPEC/S			NA
WELD		VE	RTICAL-up				S: FLOW I		YPE	40 .cfh 75% HE/25% AR
JOINT PREPARAT	TION	RE	MOVE SHEAR	OR SAW N	ARKS FRO	M F	AYING SU	RFACE	, —	ORCH TYPE BINZEL UP SIZE 3/4INCH ORIFICE
& SIDE NUMBER		RV	SCRAPING.	TTT TNC C	וגדידיוז∩ם סו	ים יו	מיים פדהם	c		
INTERPAS	S		OUME ING.	TILING C	N KOULTN	G D	OTH SIDE	<u>s</u>		
CLEANING		ST.	AINLESS ST	EEL WIRE	BRUSHING					
REPAIRS		RE	PAIR WELDS			THI	SAME ST	ANDARI	S_AS	THE ORTGINAL WORK
PREHEAT		AM	BTENT	INTERPAS TEMPERAT						
POSTHEAT						ELI	ECTRODE NTROL	TWPS	400	3
TEMPERAT HEAT	UKE	NA.				اليا	NIROL I			
TREATMEN	π	ŊΆ	·							
WELD TECHNIOU	JE	GM	AW STRINGE	R BEAD						
TRAVEL	FIL	LER	AMPERAGE	ARC			NOTES:			
SPEED (I.P.M.)	MET		RANGE	VOLTAGE RANGE	POSITIO	N				
11.5		4"	150	16	VERTICAL					
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	+									
	1				<u> </u>					
JOINT DE	SIGN:	В	2U.1/MIL.	STD. 22			THICK RA	ANGE Q	UAL.	
		SKE	TCH OF WEL	D LOCATIO	N & TYPI	CAL	PASS SE	QUENCE		. "
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.250	5									
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OUT-OF POSITION, ONE-SIDE, FULL PENETRATION WELDING OF ALUMINUM ALLOY SHEETS AND PLATES								
				LINUM ALLC	N SHEETS			D-248C;MIL-STD-278D
WELDER	MIL	-STD	-248C			PROCEDURE	- ,	PS 0900-000-1000/1
QUALIF.				 		PROCESS:	TIMAASCIT	F3 0300-000-1000/1
BASE METALS	.250 ^t	508	6 H-116 QC	-A250/19	Ì		AS METAL	ARC WELD
SPEC. TY				····		POWER SOURCE	E:MODEL	/TYPEAIRCO PA 350
FILLER N		AWS	A5.10-80	ER 5556 ·		POLARITY	DC R	
POSITION						FLUX; SPEC/S		
WELD		HOR	IZONTAL			GAS: FLOW F	RATE/TYP	E 100 CFH HELTIM
TNIOL]						TORCH TYPE BINZEL
PREPARAT	LION	REM	OVE SHEAR	OR SAW MA	ARKS FROM	FAYING SUF	RFACE	CUP SIZE 3/4 INCH ORIFICE
& SIDE		1						
NUMBER		BY	SCRAPING.	FILING. (OR ROUTIN	G BOTH SIDE	ES	
INTERPAS								
CLEANING		STA	INLESS STE	CEL WIRE	RUSHING			
REPAIRS		REP	ATR WELDS	SHALL BE	MADE TO	THE SAME ST	CANDARDS	AS THE ORIGINAL WORK
PREHEAT				INTERPAS	S			
		AMB	TENT	TEMPERAT	URE NA			
POSTHEAT	r	1				ELECTRODE	TWPS 4	.003
TEMPERA	TURE	NA_				ICONTROL		
HEAT		.						
TREATMEN	<u> </u>	NA						
WELD			II amprian	DEADG				
TECHNIO TRAVEL		LER	W STRINGER	ARC		I NOTES:		
SPEED	MET		AMPERAGE	VOLTAGE				
(I.P.M.)			RANGE	RANGE	POSITION	u		·
8.4		64"	149	.14.5	HORTZONT			
		- V						
						<u> </u>		
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JOINT D	ESIGN	: E	32 U.1/MIL.	STD. 22		THICK R	ANGE QUA	L.

SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE





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ı	عنظي					5	SPECIFICA	ATION	
SEA	ATTLE	DIVIS	SION						PAGE:
DESCRIPT	LION								34.6.300m47
									GAS METAL ARC BUTT NE APPLICATION
1/21/2020				INUM ALLC	1 SHEELS		D FLATES		248C;MIL-STD-278D
WELDER QUALIF.	MIL	-5 (D	-248C		•				0900-000-1000/1
BASE							CESS:		
METALS_	0.2	50 '' !	5456 H116	QQ-A-25	0/19		(GMAV	I) GAS META	AL ARC WELDING SHORT ARC
SPEC. T	YPE								YPE AIRCO PULSE ARC 350
FILLER N		AWS	A5.10-80	ER5556			ARITY I		
POSITION	V OF	*****	NTOAT IID					SIZE/TYPE:	
WELD		VER.	FICAL UP			GA:	5: FLOW	RATE/TYPE	40 CFH 75%HE/25%AR ORCH TYPE BINZEL
JOINT	TTON	REM	OVE SHEAR	OR SAW MA	RKS FROM	FΔ	YTNG SIII		UP SIZE 3/4 INCH ORIFICE
PREPARATE	ITON	TOME	JVII DIIIII	OIL DAN 111.	dad Inon		IIIIO DOI	dron 10	or size s/4 inon onificial
NUMBER_		BY S	SCRAPING F	ILING OR	ROUTING	вот	H SIDES		
INTERPA	SS								
CLEANING		STA	INLESS STE	EL WIRE B	RUSHING				
REPAIRS		1							
		REP	AIR WELDS			THE	SAME_ST	CANDARDS AS	S_THE_ORIGINAL_WORK
PREHEAT		AMR.	IENT	INTERPAS					
DOCT ICA		AMD.	TEMI	TEMPERAT	UKEL NA	FI	ECTRODE	TWPS 400	
POSTHEAT TEMPERAT	-	NA				1 .	NTROL	1111 5 400	
HEAT	1011								
TREATME	NT	NA							
WELD									
TECHNIO			W STRINGER				110==0		
- TRAVEL		LER	AMPERACE	ARC			NOTES:		•
SPEED		AL	AMPERAGE RANGE	VOLTAGE RANGE	POSITIO	N			
(I.P.M. 9.3		64"	115	18	VERTICA		Þ		
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ם דמזטע	ESIGN	B21	U.1/MIL.ST	D. 22			THICK R	ANGE QUAL.	
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DESCRIPT	MOIT JO	IT-OI	-POSITION	ONE-SID	E, FULL	PENE	TRATION	MANUAL GA	S METAL ARC BUTT
						AND	PLATES	FOR MARIN	E APPLICATION
WELDER	MIL	-STD	- 248C				CEDURE		248C;MIL-STD-278D
QUALIF.							CESS:	TIVAVSTILES	0900-000-1000/1
BASE METALS	.25	0" 5	5456 H-116	QQ-A250/	19			METAL ARC	WELDING
SPEC. T	YPE								YPE AIRCO PA 350
FILLER N		AWS	8 A5.10-80	ER 5556		_	ARITY	DC RP SIZE/TYPE:	NA
POSITION WELD	N OF	HOI	RIZONTAL						100 CFH HELTIM
JOINT		1101	320011111						ORCH TYPE BINZEL
PREPARA	TION	REA	10VE SHEAR	OR SAW M	ARKS FRO	M FA	YING SU	RFACE C	UP SIZE 3/4 'TNCH ORTFICE
& SIDE			000 LD TO 10	11TT T10	OD DOME	37 <i>0</i>	OMI GTS:	D.C.	·
NUMBER INTERPAS	25	BY	SCRAPING,	FILING,	OK KOUTT	NG P	KUTCH SID	<u> </u>	
CLEANING		ST	ATNLESS ST	EEL WIRE	RRUSHING				
REPAIRS		REI	PAIR WELDS	SHALL BE	MADE TO	THE	SAME S	TANDARDS A	S THE ORIGINAL WORK
PREHEAT		AMI	BIENT	INTERPAS TEMPERAT		'A			
POSTHEA	Τ						CTRODE	TWPS 400	3
TEMPERA	TURE	NA				ICO)	NTROL L		
HEAT TREATME	NIT.	NA							
WELD	N								
TECHNIO			AW STRINGE				NOTEC		
TRAVEL	1	LER	AMPERAGE	ARC VOLTAGE	!]	İ	NOTES:		
SPEED (I.P.M.) MET	-	RANGE	RANGE	POSITIO	NC			•
8.9		54"	156	14.5	HORIZON				
JOINT D	FSTGN	R'	2 U.1/MIL.	STD. 22			THICK R	ANGE QUAL.	
- GOTIAL D	LUIGIA		TCH OF WEL		N & TYPI	CAL			
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•				SPECIFICATION	PAGE:
SEA	TTLE	DIVISION			PAGE:
DESCRIPT	NOI	TT_OF_POSTTION	ONE STDE. FULL	PENETRATION MANU	JAL GAS METAL ARC BUTT
•	WE	LDING OF ALUM	INUM ALLOY SHEET	S AND PLATES FOR	MARINE APPLICATION
WELDER	MIL	-STD-248C			-STD-248C;MIL-STD-278D
QUALIF.					SHIPS 0900-000-1000/1
BASE	0.5	50" 5083 H321 (no 11.250/6	PROCESS:	AL ARC WELDING (GMAW)
METALS I		0. 3003 H3ZI (QQ-H-230/6		DEL/TYPE AIRCO PULSE ARC 350
SPEC. TY		AWS A5.10-80	ER 5556	POLARITY DC I	
POSITION				FLUX; SPEC/SIZE/	
WELD		VERTICAL-UP		GAS: FLOW RATE/	
JOINT PREPARAT	ION	REMOVE SHEAR	OR SAW MARKS F	ROM FAYING SURFACE	TORCH TYPE BINZEL CUP SIZE 3/4 INCH ORIFICE
& SIDE NUMBER		BY SCRAPING.	TILING OR ROUT	ING BOTH SIDES	
INTERPAS		COMATE TIES OF	TEEL WIRE RRUSH	TATO	
CLEANING	Z				
REPAIRS		REPAIR WELDS		TO THE SAME STANDA	ARDS AS THE ORIGINAL WORK
PREHEAT		AMBIENT	INTERPASS TEMPERATURE	NA	
POSTHEA"		NA NA		ELECTRODE TWF	PS 4003
TEMPERAT HEAT	LUKE	1111		TOWN THE TANK	
TREATME	VTT	NA		-	
WELD					
TECHNIO	<u>JE</u>	GMAW STRINGE LER	R BEAD I ARC I	I NOTES:	
TRAVEL SPEED	MET		VOLTAGE	1.0,20	
(I.P.M.		;	RANGE POSIT	ION	
12	3/6	4" 130	15.7 VERTI	CAL-UP	
					
	-				
JOINT D	ESIGN	: B2U.1/MIL.	STD. 22	THICK RANGE	
·/		SKETCH OF WEI	_D LOCATION & TY	PICAL PASS SEQUEN	UE .
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WELDING PROCEDURE

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DESCRIPT	TION							AG NORTH AND DEPM
-	(OTT-O	F-POSITION	, ONE-SID	E, FULL PEN	ETRATIO	N MANUAL G	AS METAL ARC BUTT
		VELDI	NG OF ALUM	INUM ALLO	Y SHEETS AN	D PLATE	S FOR MARI	NE APPLICATION
WELDER	MIL	-STD-	-248C			OCEDURE		248C;MIL-STD-278D
QUALIF.							INAVSHIPS	0900-000-1000/1
BASE						CESS:		
METALS	.2	50" <u>5</u>	083 H-321	<u>00-A250/6</u>			L ARC WELD	
SPEC. T	YPE		_		· · · · · · · · · · · · · · · · · · ·			YPE AIRCO PA 350
FILLER!		AWS	A5.10-80	ER 5556		LARITY		
POSITIO			_				SIZE/TYPE:	
WELD		HOR	TZONTAL		GA	s: FLOW		100 CFH/ HELTUM
TMIOL		1	.				l ==	ORCH TYPE BINZEL
PREPARA	TION	REM	OVE SHEAR	OR SAW MA	RKS FROM FA	AYING SU	RFACE C	UP SIZE 3/4 INCH ORIFICE
& SIDE								
NUMBER		BY	SCRAPING.	FILING, C	R ROUTING	BOTH SID	ES	<u></u>
INTERPA	SS							
CLEANIN		STA	INLESS STE	EL WIRE E	RUSHING			
REPAIRS		REP	AIR WELDS			E SAME S	TANDARDS_A	S THE ORIGINAL WORK
PREHEAT		1		INTERPAS		,		
		AME	IENT	TEMPERAT				
POSTHEA	T	1				ECTRODE	TWPS 400	13
TEMPERA	TURE	NA				NTROL		
HEAT		1						
TREATME	NT	NA						
WELD		j						
TECHNIO	UE	GMA	W STRINGER				 	
TRAVEL		LLER		ARC		NOTES:		
SPEED	ME	TAL	AMPERAGE	VOLTAGE				
(I.P.M.			RANGE	RANGE	POSITION	ļ .		
10.2	3/	64"	145	14.5	HORIZONTAL	1		

JOINT DESIGN: B2 U.1/MIL. STD. 22

B2 U.1/MIL. STD. 22 THICK RANGE QUAL.

SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE ₩ EDGE

APPROVALS:

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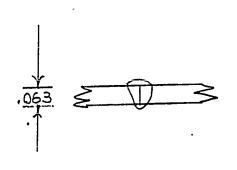
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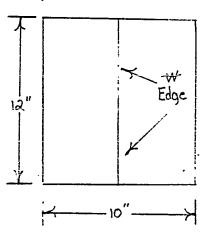
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MECHANIZED FLAT, ONE-SIDE, FULL PENETRATION GAS METAL ARC BUTT
WEIDING OF ALUMINUM ALLOY SHEETS: AND PLATES FOR MARINE APPLICATION

WELDING OF ALUMINUM ALLOY SHEETS AND PLATES FOR MARINE APPLICATION												
WELDER QUALIF.	MIL	L-STD-248C					PROCEDURE MIL-STD-248C;MIL-STD-278D QUALIF.STD. NAVSHIPS 0900-000-1000/1					
BASE METALS	.063	3" 50	086 H-32 C	Q-A-250/7	7	PR	OCESS: GAS MET	TAL	ARC W	ELDING (GM	AW)	
SPEC. TYP		AWS	A5.10-80	Er 5356			WER SOUR		;MODEL,	/TYPEGTT.LI	LAND C	V600 FI-PA
POSITION				•			UX;SPEC/					
WELD		FLA	\T			<u>I GA</u>	S: FLOW	_RA	JE/TYP	= 40 CFH		
JOINT PREPARATI	ION	REN	OVE SHEAR	OR SAW MA	ARKS FROM	í FA	YING SUI	RFA	CE	TORCH TYP	3/4 I	4001 NCH ORIFICE
& SIDE		DW	SCRAPING,	ETITMO OI	ם ארווידאור	י פרי	TH STNE	g.				
NUMBER		DI	SCRAPING.	FILLING OF	KOULLING	, DC	TH SIDES	3				
INTERPASS CLEANING	5	STA	AINLESS ST	EEL WIRE 1	BRUSHING							
REPAIRS		REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK						WORK				
PREHEAT		AMBIENT TEMPERATURE NA										
POSTHEAT TEMPERATU		NA	Man Maratra				ECTRODE NTROL		TWPS 4	003		
HEAT TREATMENT		NA	•		<u>-</u>							
WELD TECHNIOUE		GM/	AW STRINGE	R BEAD								•
TRAVEL		LER I	1	ARC			NOTES:					
SPEED	MET		AMPERAGE	VOLTAGE								
(I.P.M.)	SIZ		RANGE	RANGE	POSITIO	N						
24.5	3/64" 50 13.5 FLAT 60 PPS											
							MECHAN:	IZE	ED BUG-	0		
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SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE





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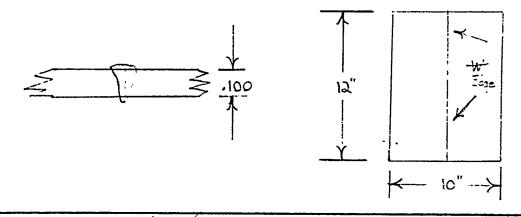
MECHANIZED FLAT, ONE-SIDE, FULL PENETRATION GAS METAL ARC BUTT WELDING OF ALUMINUM ALLOY SHEETS AND PLATES FOR MARINE APPLICATION

WELDER QUALIF.	MIL	L-STD-248C					PROCEDURE MIL-STD-248C;MIL-STD-278D OUALIF.STD. NAVSHIPS 0900-000-1000/1				
BASE METALS	.10	0 '' 5086 1	H-32	QQ-A-250/	7	PRO	CESS: GA	s M	ÆŢAL A	ARC WELDING (GMAW)	
SPEC. TY FILLER M		AWS A5.	10–80	ER 5356		POW POI	ER SOUR	CE;	MODEL.	TYPE GILLILAND CV600 FI-PA	
POSITION WELD		FLAT				FLU	JX;SPEC/	SIZ	E/TYPI	E: NA E 40 CFH	
JOINT PREPARAT	ION		SHEAR	OR SAW MA	ARKS FROM					TORCH TYPE MTG 4001 CUP SIZE 3/4 INCH ORIFICE	
& SIDE NUMBER		BY SCRA	PING,	FILING OF	R ROUTING	BOT	TH SIDES	3			
INTERPAS CLEANING		STAINLE	SS ST	EEL WIRE E	BRUSHING		 		 		
REPAIRS		REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK						AS THE ORIGINAL WORK			
PREHEAT		AMBIENT		INTERPAS TEMPERAT	37.1						
POSTHEAT TEMPERAT		NA					LECTRODE TWPS 4003 ONTROL				
HEAT TREATMEN	π	NA									
WELD TECHNIOU	E	GMAW ST	RINGE	R BEAD						·	
TRAVEL SPEED (I.P.M.)	. FILLER		NOTES:								
22							MECHANIZED BUG-O				
	 										
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JOINT DESIGN: BIS.1/MTL. STD. 22

THICK RANGE QUAL.

SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE



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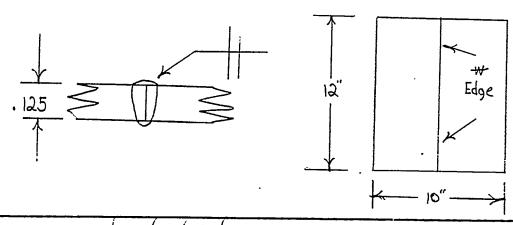
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DESCRIPTION
MECHANIZED FLAT, ONE-SIDE, FULL PENETRATION GAS METAL ARC BUTT
WELDING OF ALUMINUM ALLOY SHEETS AND PLATES FOR MARINE APPLICATION

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WELDER QUALIF.	MIL	L-STD-248C					ROCEDURE MIL-STD-248C;MIL-STD-278D UALIF.STD, NAVSHIPS 0900-000-1000/1				
BASE METALS	.125	j'' 5	083 - H323			Pi	ROCESS:		ARC WELDING (GMAW)		
SPEC. TYP		WA	S A5.10-80	ER 5356			OWER SOUR		EL/TYPEGILLILAND CV600 FI-PA		
POSITION WELD	OF	FL	ΔΨ			FI	UX;SPEC/	SIZE/T	YPE: NA YPE 40 CFH		
JOINT PREPARATI	ON		MOVE SHEAR	OR SAW MA	ARKS				TORCH TYPE MTG 4001 CUP SIZE 3/4 INCH ORIFICE		
& SIDE NUMBER		BY	SCRAPING,	FILING O	R RO	OUTING B	OTH SIDES	5			
INTERPASS CLEANING		ST.	AINLESS STI	EEL WIRE 1	BRUS	HING					
REPAIRS		RE	PAIR WELDS	SHALL BE	MAD	E TO TH	E SAME ST	randard	S AS THE ORIGINAL WORK		
PREHEAT		AM	BIENT	INTERPAS TEMPERAT	S URE	NA					
POSTHEAT TEMPERATU	RE_	NA				E	ECTRODE NTROL	TWPS	4003		
HEAT TREATMENT		NA									
WELD TECHNIQUE			AW STRINGEI	R BEAD					•		
TRAVEL SPEED (I.P.M.)			AMPERAGE RANGE	ARC VOLTAGE RANGE	PO:	SITION	NOTES: 60 PPS				
16.2	ME ME					MECHAN	TSED BO	G - D			
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SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE



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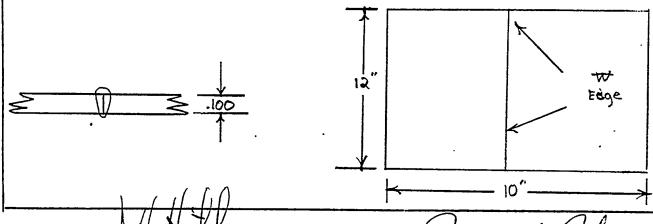
DESCRIPTION

MECHANIZED FLAT, ONE-SIDE, FULL PENETRATION GAS METAL ARC
BUTT WELDING OF ALUMINUM ALLOY SHEETS AND PLATES FOR MARINE APPLICATION

WELDER MIL-STD-248C PROCEDURE MIL-STD-248C; MIL-STD-278D QUALIF. STD. NAVSHIPS 0900-000-1000/1 PROCEDURE MIL-STD. NAVSHIPS 0900-000-1000/1 PROCESS: PROCESS: PULSE GAS METAL ARC WELDING (GMAW) POWER SOURCE; MODEL/TYPEMILLER PULSTAR 450 POWER SOURCE; MODEL/TYPEMILLER PULSTAR 450 POLARITY DCRP POWER SOURCE; MODEL/TYPEMILLER PULSTAR 450 POLARITY DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TORCH TORCH TSTHE/25%AR DCRP TORCH TSTHE/25%AR DCRP TSTHE/25%AR DC		·								
BASE METALS .125" 5083 H-323 QQ-A-250/6 PROCESS: PROCESS: PROCESS: PULSE GAS METAL ARC WELDING (GMAW) POWER SOURCE; MODEL/TYPEMILLER PULSTAR 450 POSITION OF WELD POSITION OF WELD POSITION FLAT JOINT PREPARATION \$ SIDE NUMBER BY SCRAPING, FILING OR ROUTING BOTH SIDES INTERPASS CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT POSTHEAT TREMETATURE HEAT TREATMENT WELD TRAVEL SPEED METAL AMPERAGE CI.P.M.) SIZE RANGE RANGE RANGE RANGE RANGE RANGE RANGE RANGE RANGE ROUTING PROCESS: PULSE GAS METAL ARC WELDING (GMAW) POULS IN POULS AS METAL ARC WELDING (GMAW) POULS AND POULS AS METAL ARC WELDING (GMAW) POLAD TRAVEL FILLER METAL AMS A5.10-80 POWER SOURCE; MODEL/TYPEMILLER PULSTAR 450 POLAD FILLER PULSTAR 450 FLUX; SPEC/SIZE/TYPE: NA TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE COUNTRIL WORK PROCESS: POCH OF POULS AND POU		MIL	-STD-	248C			, , , , , , , , , , , , , , , , , , , ,			
METALS .125" 5083 H=323 QQ-A=250/6 PULSE GAS METAL ARC WELDING (GMAW)										
SPEC. TYPE FILLER METAL AWS A5.10-80 POSITION OF WELD POSITION OF WELD JOINT PREPARATION REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE NUMBER NUMBER REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT TEMPERATURE HEAT TREATMENT TREATMENT TREATMENT TRACE SPEED METAL AMPERAGE CIP. SIZE ANGE POSITION POSITION POSITION POSITION POSITION POSITION POSITION COMMANDER BY SCRAPING, FILING OR ROUTING BOTH SIDES STAINLESS STEEL WIRE BRUSHING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT TEMPERATURE HEAT TREATMENT NA WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION FLAT MECHANIZED BUG-O MECHANIZED BUG-O			-11 -0		00 4 050	10		GE GAG 30	THAT ADD THE DESCRIPTION	
FILLER METAL AWS A5.10-80 POSITION OF WELD WELD JOINT PREPARATION & SIDE NUMBER REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT POSTHEAT TEMPERATURE HEAT TEMPERATURE HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL SPEED METAL AMPERAGE (I.P.M.) SIZE RANGE RANGE RAW STANDER ARC VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION POLARITY DCRP FLUX; SPEC/SIZE/TYPE: NA FLUX; SPEC/SIZE/TYPE: NA FAURCH 75%HE/25%AR FOUR ATTEMPERATURE BORN FAYING SURFACE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE SHE AND THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT INTERPASS ITEMPERATURE NA ELECTRODE CONTROL NOTES: NOTES: NOTES: WECHANIZED BUG-0			<u>5'' 508</u>	83 H-323	QQ-A-250	/ 6				
POSITION OF WELD WELD JOINT PREPARATION \$ SIDE NUMBER INTERPASS CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT TEMPERATURE HEAT TEMPERATURE HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER SPEED METAL AMPERAGE (I.P.M.) SIZE RANGE RANGE RANGE REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE GAS: FLOW RATE/TYPE 40 CFH 75%HE/25%AR TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE SOUR SURFACE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE SOUR SIZE 3/4 INCH ORIFICE ELECTRODE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE SOUR SIZE 3/4 INCH ORIFICE ELECTRODE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE SOUR SIZE 3/4 INCH ORIFICE ELECTRODE TWPS 4003 CONTROL NOTES: SPEED METAL (I.P.M.) SIZE RANGE RANGE RANGE POSITION FOR PAYING SURFACE CUP SIZE 3/4 INCH ORIFICE FOR OTHER TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE ELECTRODE TWPS 4003 TWPS 4003 CONTROL NOTES: SPEED METAL (I.P.M.) SIZE RANGE RANGE RANGE RANGE RANGE POSITION MECHANIZED BUG-0 MECHANIZED BUG-0									/TYPEMILLER PULSTAR 450	
WELD JOINT PREPARATION & SIDE NUMBER NUMBER REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE CUP SIZE 3/4 INCH ORIFICE REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH			AWS A	A5.10-80					1-7"1-d-1-, 1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	
JOINT PREPARATION & SIDE NUMBER BY SCRAPING, FILING OR ROUTING BOTH SIDES INTERPASS CLEANING REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT TEMPERATURE HEAT TREATMENT NA WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL SPEED (I.P.M.) SIZE RANGE REMOVE SHEAR OR SAW MARKS FROM FAYING SURFACE TORCH TYPE AH 35 C-2 CUP SIZE 3/4 INCH ORIFICE CUP SIZE 3/4 INCH		1 OF								
PREPARATION & SIDE NUMBER BY SCRAPING, FILING OR ROUTING BOTH SIDES INTERPASS CLEANING STAINLESS STEEL WIRE BRUSHING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT AMBIENT INTERPASS TEMPERATURE NA INTERPA			FLAT				GAS: FLOW	RATE/TYP		
S SIDE NUMBER NUMBER BY SCRAPING, FILING OR ROUTING BOTH SIDES INTERPASS CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT TEMPERATURE NA POSTHEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL SPEED METAL AMPERAGE (I.P.M.) SIZE RANGE RANGE RANGE RANGE POSITION MECHANIZED MECHANIZED BUG-O MECHANIZED BUG-O	TNIOL		· •						TORCH TYPE AH 35 C-2	
SIDE NUMBER NUMBER BY SCRAPING, FILING OR ROUTING BOTH SIDES INTERPASS CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT POSTHEAT TEMPERATURE HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER SPEED METAL AMPERAGE (I.P.M.) SIZE RANGE RANGE RANGE POSITION MECHANIZED BUG-O MECHANIZED BUG-O	PREPARAT	TION	REMO	VE SHEAR (OR SAW MA	RKS FROM	FAYING SUR	FACE	CUP SIZE 3/4 INCH ORIFICE	
INTERPASS CLEANING REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT POSTHEAT TEMPERATURE NA HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER SPEED METAL (I.P.M.) SIZE RANGE RANGE RANGE POSITION MECHANIZED BUG-0	& SIDE									
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REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT AMBIENT INTERPASS TEMPERATURE NA POSTHEAT TEMPERATURE NA HEAT TREATMENT NA WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL SPEED (I.P.M.) SIZE RANGE RANGE RANGE RANGE RANGE POSITION MECHANIZED BUG-O MECHANIZED BUG-O	INTERPAS	SS				_				
REPAIRS REPAIR WELDS SHALL BE MADE TO THE SAME STANDARDS AS THE ORIGINAL WORK PREHEAT AMBIENT INTERPASS TEMPERATURE NA POSTHEAT TEMPERATURE NA ELECTRODE TWPS 4003 CONTROL TWPS 4003 CONTROL TRAYEL TRAYEL FILLER SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE RANGE POSITION MECHANIZED BUG-O MECHANIZED BUG-O	CLEANING	;	STAI	NLESS STE	EL WIRE B	RUSHING				
PREHEAT AMBIENT INTERPASS TEMPERATURE NA POSTHEAT TEMPERATURE NA HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER SPEED METAL AMPERAGE (I.P.M.) SIZE RANGE RANGE RANGE POSITION MECHANIZED BUG-O MECHANIZED BUG-O										
POSTHEAT TEMPERATURE NA POSTHEAT TEMPERATURE NA HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-O	REPAIRS		REPA:	IR WELDS	SHALL BE	MADE TO I	HE SAME ST	ANDARDS A	AS THE ORIGINAL WORK	
POSTHEAT TEMPERATURE NA CONTROL HEAT TREATMENT NA WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION MECHANIZED BUG-O METAL MECHANIZED BUG-O	PREHEAT				INTERPAS	s				
TEMPERATURE NA CONTROL HEAT TREATMENT NA WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0			AMBI	ENT	TEMPERAT	URE NA				
TEMPERATURE NA CONTROL HEAT TREATMENT NA WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0	POSTHEAT	•		-			ELECTRODE TWPS 4003			
HEAT TREATMENT WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0	TEMPERAT	URE	NA				The state of the s			
WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-O										
WELD TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC NOTES: SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0	TREATMEN	ır l	NA					•		
TECHNIQUE GMAW STRINGER BEAD TRAVEL FILLER ARC NOTES: SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-O										
TRAVEL FILLER ARC NOTES: SPEED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0		JE .	GMAW	STRINGER	BEAD				•	
SPED METAL AMPERAGE VOLTAGE (I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0			LER I	· · · · · · · · · · · · · · · · · · ·	ARC		I NOTES:			
(I.P.M.) SIZE RANGE RANGE POSITION 60 PPS 16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-0		1		AMPERAGE						
16.1 3/64" 70 21.2 FLAT MECHANIZED BUG-O						POSTTION	d 60 PPS			
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JOINT DESIGN: B1S.1/MIL. STD. 22 THICK RANGE QUAL.	JOINT DE									

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SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE



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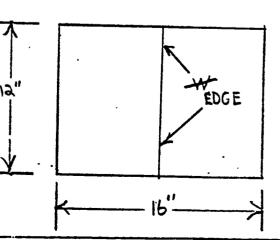
James C. Johnston

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DESCRIPT							•			,
•	-;	MECH	ANIZED FLA	T ONE-SID	Ε, Ε	FULL PEN	ETRATION	GAS METAI	A	RC BUTT
				INUM ALLO	Y S				_	APPLICATION
WELDER QUALIF.	MIL	. – ST[)–248C)	ROCEDURE UALIF.ST			.48C;MIL-STD-278D .0900-000-1000/1
BASE							ROCESS:			
METALS		50" !	5086 H-116	QQ-A-250/	19		PULSE GA	S METAL A	RC	WELDING
SPEC. TY		AWS	S A5.10-80	ER 5556			OWER SOULD	RCE;MODEL, DCRP	/TY	PE MILLER PULSTAR 450
POSITION			,					/SIZE/TYPE	<u> </u>	NA
WELD		FL	AT MECHANIZ	ED				RATE/TYPE		40 CFH 75%HE/25%AR
TNIOL		1								RCH TYPE AIRCO AH 35-C2
PREPARAT	ION	REI	MOVE SHEAR	OR SAW MA	RKS	FROM FA	YING SUR	FACE	CU	P SIZE3/4" ORIFICE
& SIDE			660 I D TW6	TTT TYO 6				_		
NUMBER INTERPAS:		BX	SCRAPING,	FILING OR	. RO	UTING BU	TH SIDES	<u> </u>		
CLEANING		STA	AINLESS STE	ET. WTRE B	RIIS	HTNG				
REPAIRS						•				
		REI	PAIR WELDS			E TO THE	SAME ST	ANDARDS A	S 3	THE ORIGINAL WORK
PREHEAT		AMI	BIENT	INTERPAS TEMPERAT		AMBIEN	ĬТ			
POSTHEAT				TIEMPERAT	UKE	·	LECTRODE	TWPS 40	10.7	
TEMPERATI		NA				4	CONTROL			
HEAT							-1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	•	-	
TREATMENT	τ	NA	 					•		
WELD		CM	W STRINGER	PEADE					_	•
TECHNIQUE										
TRAVEL SPEED	MET	LER		ARC			NOTES:			•
(I.P.M.)	SIZ		AMPERAGE RANGE	VOLTAGE	BO	CITION	}			
16	3/6	120 DDC								
12.2	3/6		105	24	FL		MECHANIZED BUG-O			
		27 FIRI					****OUGHTEEN DOG-O			
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JOINT DES	JOINT DESIGN: B2U.1/MIL.STD. 22 THICK RANGE QUAL.									
	SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE									

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APPROVALS:

James C. Johnston

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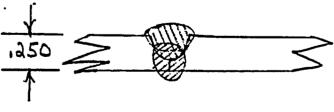
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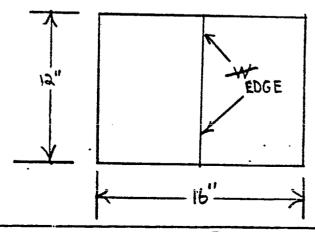
SEATTLE DIVISION
DESCRIPTION

MECHANIZED FLAT, ONE-SIDE, FULL PENETRATION GAS METAL ARC BUTT WELDING OF ALUMINUM ALLOY SHEETS AND PLATES FOR MARINE APPLICATION

WELDER QUALIF.	MIL	-STD	-248C			PROCEDURE MIL-STD-248C; MIL-STD-278D OUALIF.STD. NAVSHIPS 0900-000-1000/1			
BASE METALS	.25	0" 5	086 H-116	QQ-A-250/1	.9	PROCESS:	ILSE GAS METAL ARC WELDING		
SPEC. TY FILLER M		AWS	A5.10-80	ER 5356		POWER SOUR POLARITY	CE; MODEL/TYPE AIRCO PA 350 DCRP		
POSITION WELD	OF	FLA	T MECHANIZ	ED			SIZE/TYPE:NA RATE/TYPE 40 CFH 75%HE/25%AR		
JOINT PREPARAT	ION	REM	OVE SHEAR	OR SAW MA	RKS FROM	FAYING SUR	FACE TORCH TYPE BINZEL CUP SIZE 3/4" ORIFICE		
& SIDE NUMBER		ВЧ	SCRAPING,	FILING OR	ROUTING	BOTH SIDES			
INTERPAS CLEANING		STA	INLESS STE	EL WIRE B	RUSHING	 			
REPAIRS		REF	AIR WELDS	SHALL BE	MADE TO	THE SAME STANDARDS AS THE ORIGINAL WORK			
PREHEAT	PREHEAT INTERPASS ATTEMPERATURE AT					BIENT			
POSTHEAT TEMPERAT		NA ELECTRODE TWPS 4003					TWPS 4003		
HEAT TREATMEN	Τ	NA							
WELD TECHNIOU	E	STF	RINGER BEAL)S			·		
TRAVEL SPEED (I.P.M.)	MET	ILLER AMPERAGE VOLTAGE IZE RANGE RANGE POSITIO		POSITIO	NOTES:	•			
12.2	3/64		92	24.8	FLAT	MECH	ANIZED BUG-O		
16	16 3/64" 124 26.5		26.5	FLAT	ELEC	TRONICALLY PROGRAMMED WIRE FEED			
JOINT DE	JOINT DESIGN: B2U.1/ MIL.STD. 22 THICK RANGE QUAL.								
	CVETCH OF MELD LOCATION C. TYDICAL DAGG CERTIFICE								

SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE





APPROVALS:

James C Johnston

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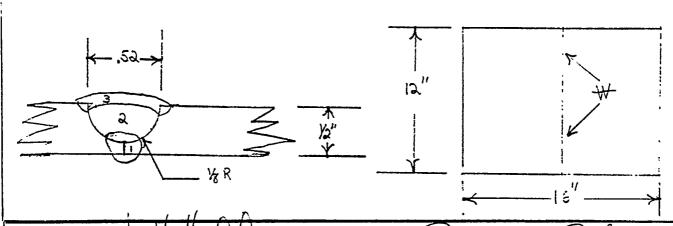
SEAT	 DIL	110	TA	
DEAL	DIV	12	יאטנו	

ESCRIPTION	MECHANIZED	FLAT, O	NE-SIDE,	FULL	PENET	TRATION	GAS	METAL A	RC BUTT	
	WEIDING OF	AT.IIMTNII	YOUTLE M	SHEETS	AND	PT.ATES	FOR	MARTNE	APPLTCAT	TON

	V	ELDING OF ALU	MINUM ALL	OX SHEETS I	MD PLATE	5 FUR MAK	INE APPLICATION		
WELDER	MTI	-STD-248C		PI	ROCEDURE MIL-STD-248C; MIL-STD-278D				
QUALIF.		. 3(D 1 100			OUALIF.STD. NAVSHIPS 0900-000-1000/1				
BASE				PF	OCESS:				
	- 500 3	INCH 5083-H321 QQ-A-250/6)/6 P	PULSE GAS METAL ARC WELDING				
SPEC. TY				PC	WER SOUR	CE; MODEL/	TYPE MILLER PULSTAR 450		
FILLER N		AWS A5.10-8	0 ER 5356	P	LARITY I	CRP			
POSITION				FI	UX; SPEC/	SIZE/TYPE	: NA		
WELD	,	FLAŤ		G/	S: FLOW	RATE/TYPE	40 CFH 75%HE/25%AR		
JOINT							TORCH TYPE AH 35-C2		
PREPARAT	TION	REMOVE SHEA	R OR SAW_	MARKS FROM	FAYING S	URFACE	CUP SIZE 3/4 INCH ORIFICE		
& SIDE									
NUMBER		BY SCRAPING	FTLING	OR ROUTING	ROTH SIL	ES.			
INTERPAS	SS		,						
CLEANING	;	STATNLESS S	TEEL WIRE	BRIISHING					
REPAIRS		REPATR WELL	S SHALL R	F MADE TO '	THE SAME	STANDARDS	AS THE ORIGINAL WORK		
PREHEAT		INTERPASS							
		AMBIENT TEMPERATURE AMBIENT							
POSTHEAT	7			E	LECTRODE	TWPS 40	03		
TEMPERAT	URE	NA CONTROL NA							
HEAT									
TREATMEN	1	NA							
WELD									
TECHNIO		GMAW STRING							
TRAVEL	FIL	LER	ARC		NOTES:	120 pps			
SPEED	MET	AL AMPERAGE			MECHANIZED BUG-O				
(I.P.M.			RANGE	POSITION	1				
14	3/64	150	25	FLAT	1				
11.5	3/64	160	28	FLAT					
11.5	3/64	" 157	28	FLAT					
					1				
					4				
	1		i	l <u>.</u>	1				

JOINT DESIGN: B2U.1/MIL. STD. 22 THICK RANGE QUAL.

SKETCH OF WELD LOCATION & TYPICAL PASS SEQUENCE



APPROVALS:

James C. Johnston

GENERAL CONCLUSIONS AND RECOMMENDATIONS

General conclusions and recommendations that were generated from the analysis of the test results of this program are listed as follows:

- 1. All four pulse gas metal arc welding power sources were capable of making out-of-position, one-side, full penetration, manual pulse gas metal arc butt welds in 5000 series aluminum alloy sheet and plate for marine structure applications.
- 2. Pulsed gas metal arc welding power sources, wire feed systems and two position manual GMAW torches are available at prices comparable to conventional gas metal arc welding systems.
- 3. Single knob adjustments of pulse peak voltage, pulse background and induction have eliminated the element of complexity in setting the welding parameters.
- 4. With the advent of newer pulse welding machines, it is anticipated that more and more manual pulse spray and "pulse short-circuiting" arc welding of 5000 series aluminum alloy sheet and plates for fabrication of marine structures will take place.
- 5. Pulsed spray and "pulsed short-circuiting" gas metal arc welding processes and techniques are keys to preventing weld distortions and handling out-of-position joining of marine aluminum alloy sheet and plates.